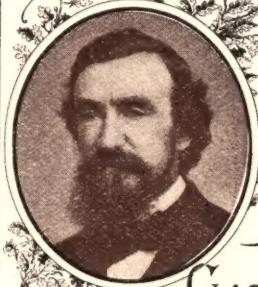


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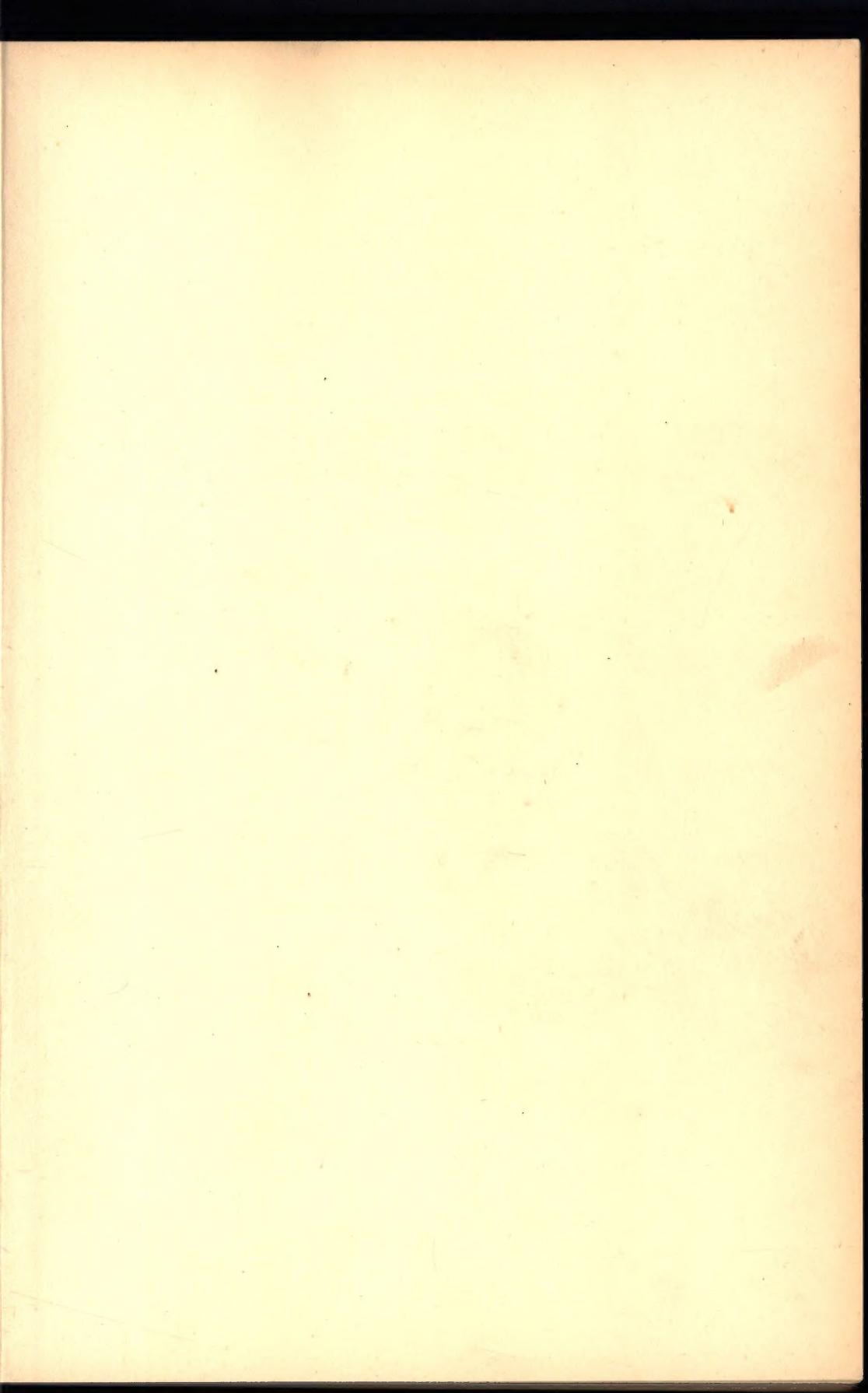
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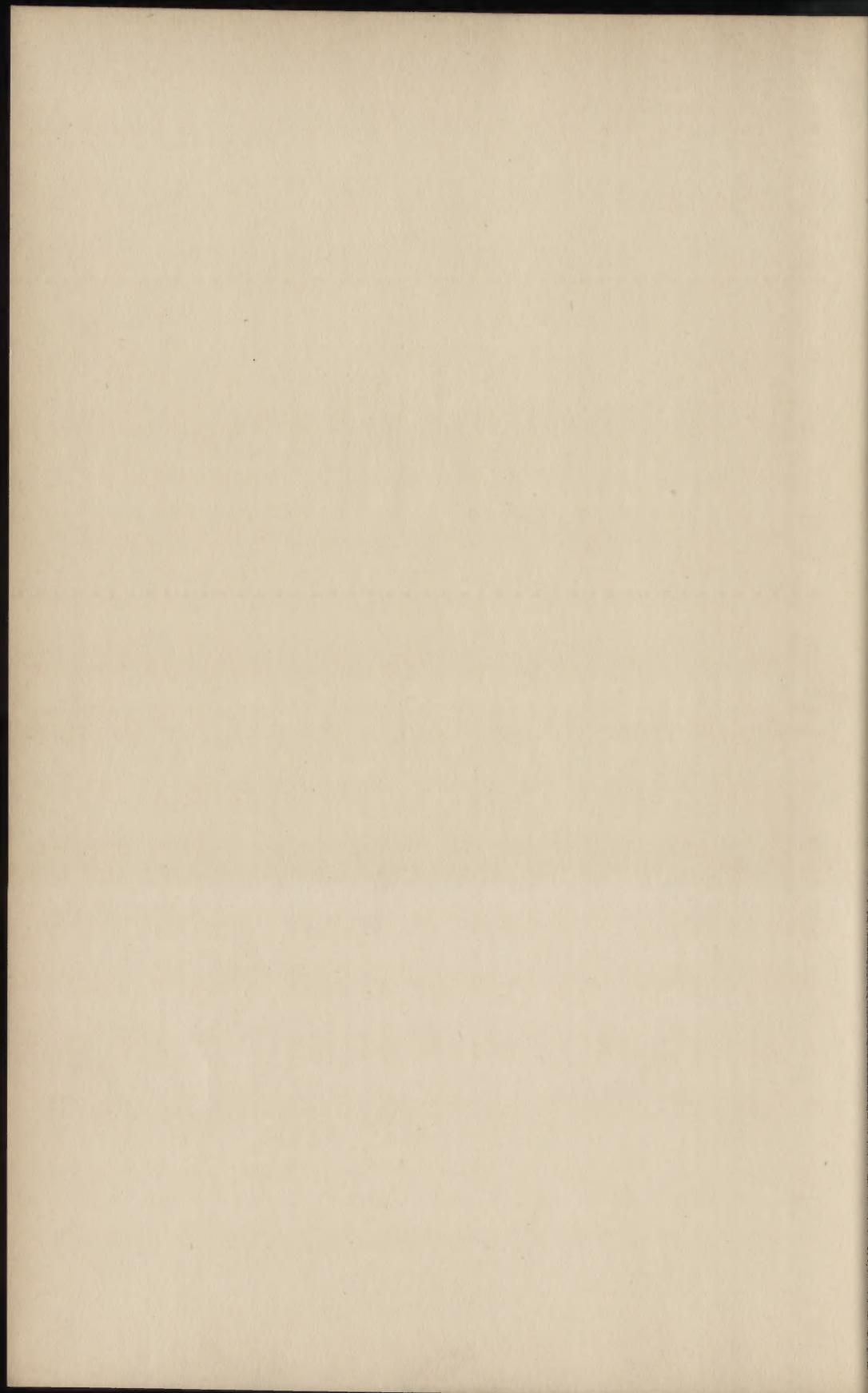
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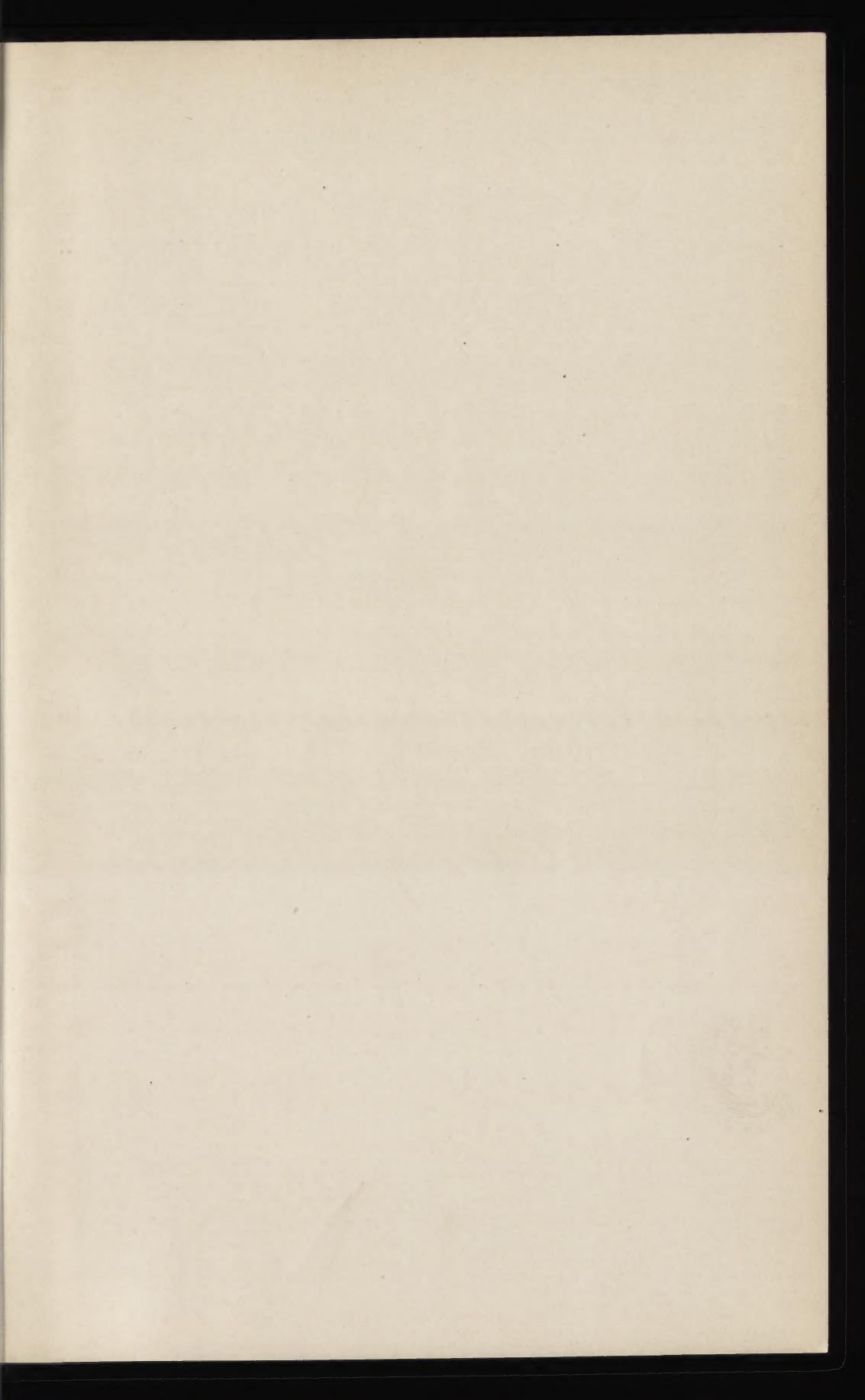


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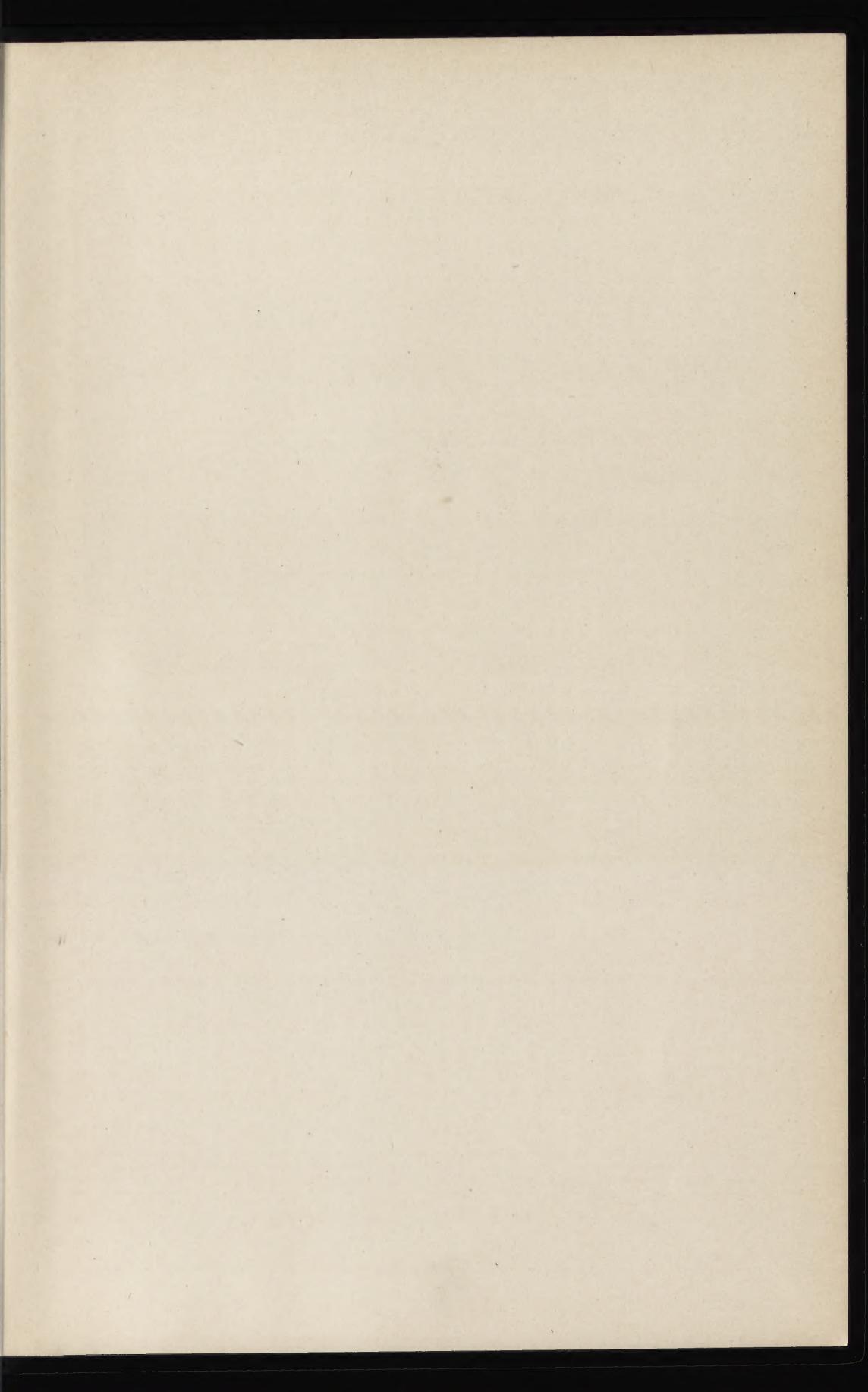
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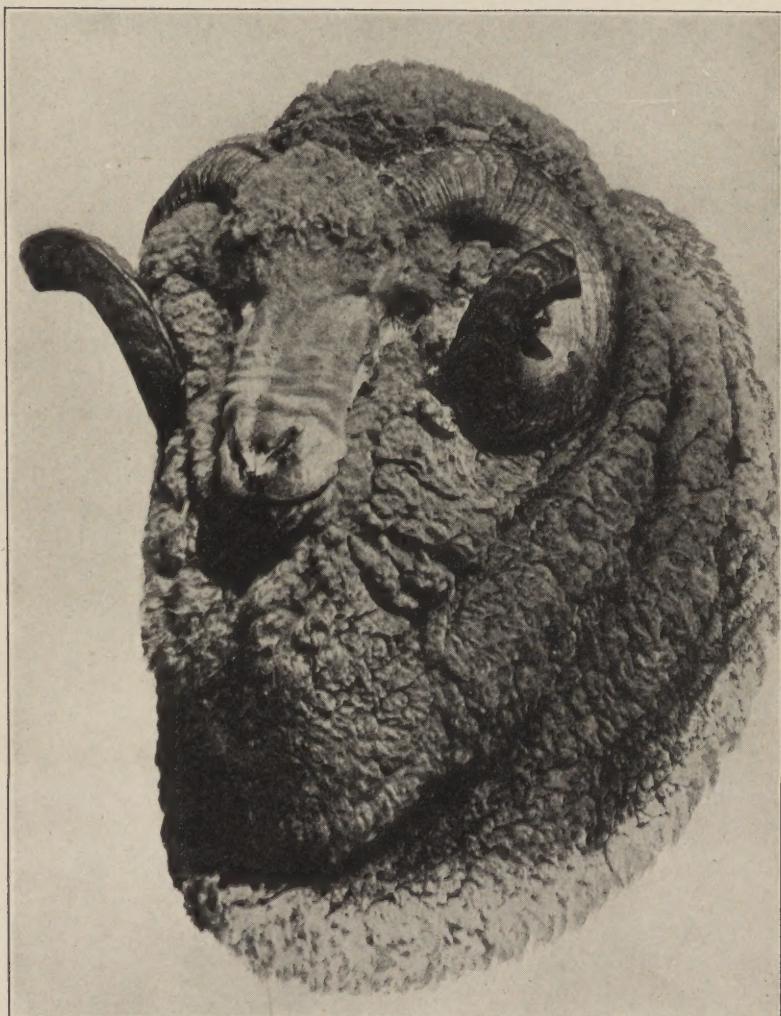












An Australian Representative

# WOOL

## THE RAW MATERIALS OF THE WOOLEN AND WORSTED INDUSTRIES

BY

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REVISED BY EDWARD W. FRANCE

1924

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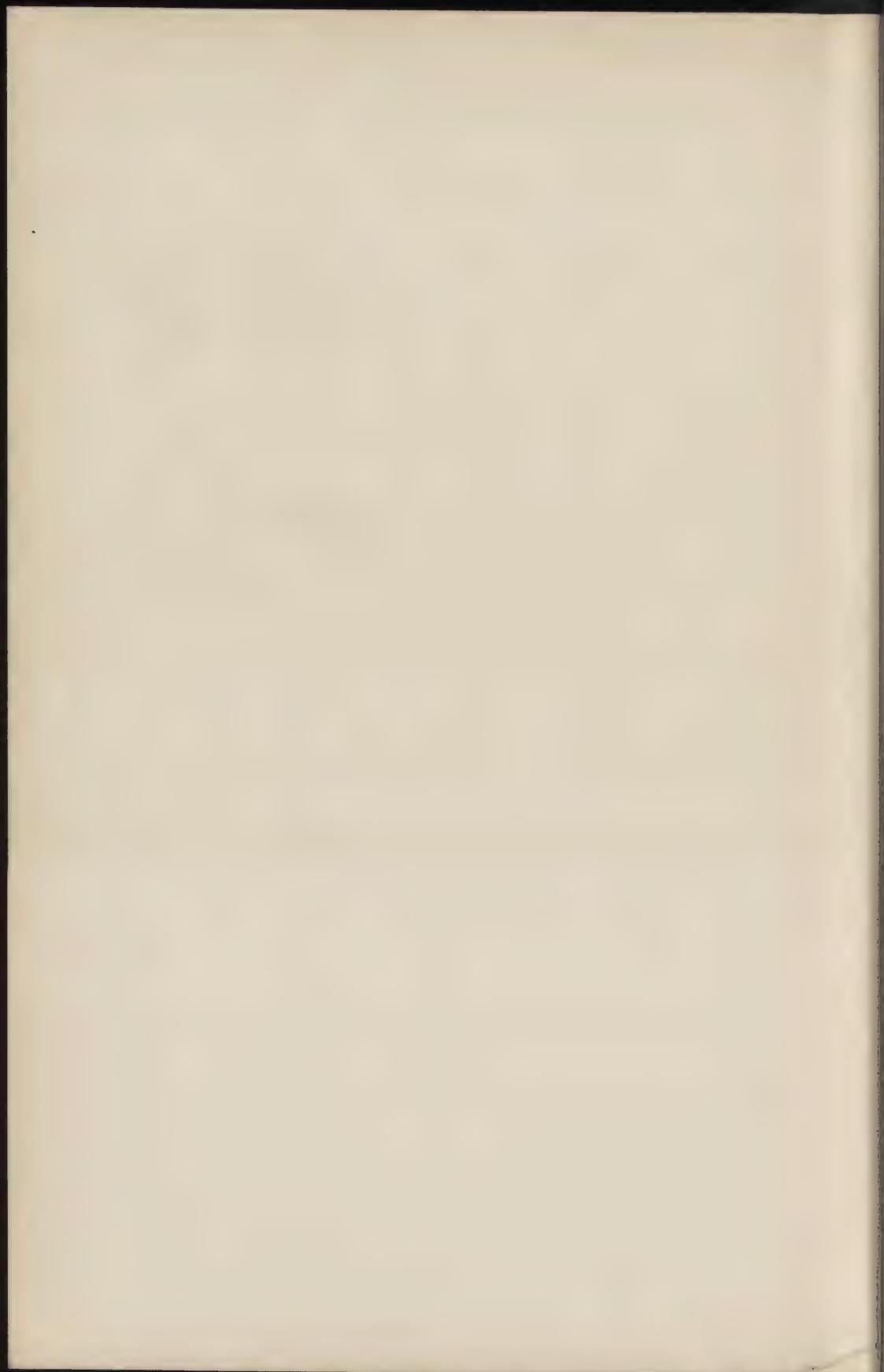
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TO

**Mr. Theodore C. Search**

IN GRATEFUL APPRECIATION  
OF HIS INTEREST IN  
TEXTILE EDUCATION  
THIS VOLUME IS  
RESPECTFULLY DEDICATED  
BY THE AUTHOR

84983



## PREFACE

The following pages have been prepared for use as a text book in connection with the course of study in "The Raw Materials of the Wool Industries" at the Philadelphia Textile School. Numerous books on general textiles and on woolen and worsted spinning touch lightly on the raw materials of these important branches of the textile industry in a general way, but in none of them has the subject been covered in the detailed manner which its importance deserves, hence an effort is here made to follow the various raw materials of the woolen and worsted industry from their origin to the point where actual machine processing begins.

Considerable information was obtained from the Report of the Tariff Board on Schedule "K" in 1912; Matthews' "Textile Fibers"; Wright's "Wool-growing and the Tariff"; and various United States government reports and pamphlets by the Animal Husbandry Division. The statistics contained in the Appendix are mostly from the Bulletins of the National Association of Wool Manufacturers.

A large number of excellent photographs, generously furnished for illustration by Hon. John Bright, Canadian Live Stock Commissioner, are highly appreciated. The sheep and goat pamphlets issued by his department, cover their subject in a thorough manner.

Information of great value, including the various classified lists of sheep, was generously furnished by Mr. W. T. Ritch, the well-known Australian wool expert. Several passages were taken from the report to the Canadian Government in 1911 by Messrs. W. A. Dryden and W. T. Ritch on "The Sheep Industry in Canada, Great Britain and United States." Mr. F. M. Jennings, at present with the Canadian Live Stock Branch and for many years Instructor in The Wool Grading and Sorting Course of the Philadelphia Textile School, furnished considerable valuable information.

A large portion of the introduction is from a lecture delivered before the Franklin Institute by Mr. Theodore C. Search, former President of the Pennsylvania Museum and School of Industrial Art.

The descriptions of various breeds of sheep were improved by reference to Dr. Carl W. Gay's recent book, "The Principles and Practice of Judging Live Stock." Several passages are quoted from Dr. Gay's book, and acknowledgment of the privileges extended by the author and publisher is a pleasant duty.

Thanks are also extended to the Bureau of Animal Industry of the United States Department of Agriculture; the Commercial Museum, Philadelphia; and numerous individual sheep breeders, firms, and sheep breeders' associations, who generously furnished photographs. To Mr. Richard S. Cox, thanks are extended for the drawings which are reproduced.

The manuscript has been carefully edited by Mr. Edward W. France, Director of the Philadelphia Textile School, and thanks are extended for his co-operation and suggestions in its preparation.

In conclusion, it is hoped that the book may prove useful to laymen seeking knowledge of the raw materials of the woolen and worsted industries, and that it may also be of value as a reference book in educational institutions conducting textile, agricultural, commercial, industrial, and domestic art courses.

PHILADELPHIA, January, 1917.

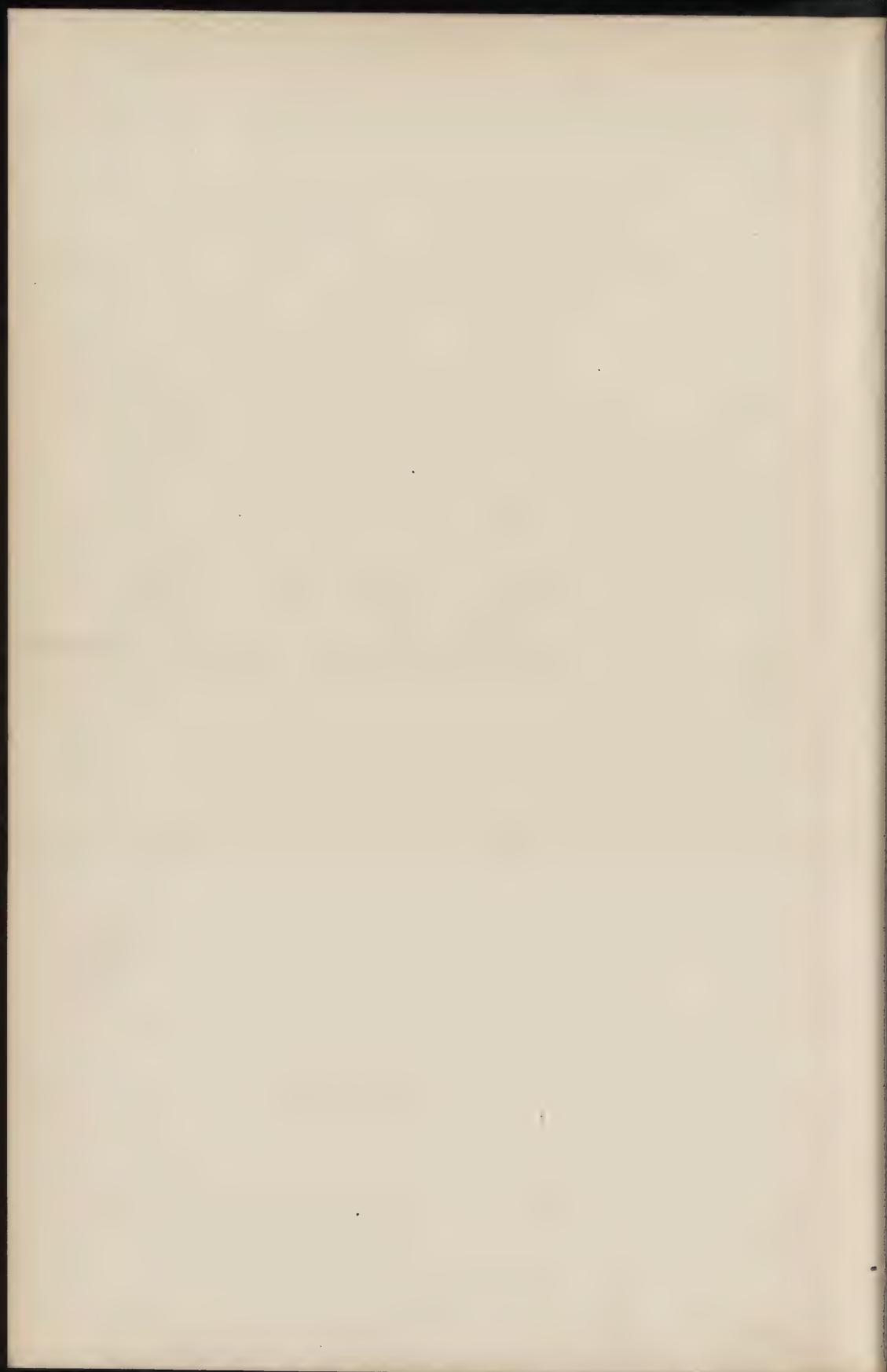
#### PREFACE TO SECOND EDITION

Essentially, the second edition of Mr. Hart's highly esteemed work on "Wool" is a reprint. However, it has appeared advisable to make a rearrangement of certain chapters, more nearly to approximate actual sequence of thought and practice. It has also seemed fitting that certain paragraphs should be expanded, the better to present phases of the subject for the consideration of the layman, thus continuing to strive toward the original

goal—the making of a book of practical value. Insofar as it has been advisable and possible, tables in the appendix have been revised or replaced by others more up-to-date or more comprehensive. Grateful acknowledgment is made for the use of two illustrations from Dr. F. H. Bowman's work on "The Structure of the Wool Fiber," as well as to all those who have so freely assisted in the furnishing of the material that has made the revision possible.

E. W. F.

September, 1924.



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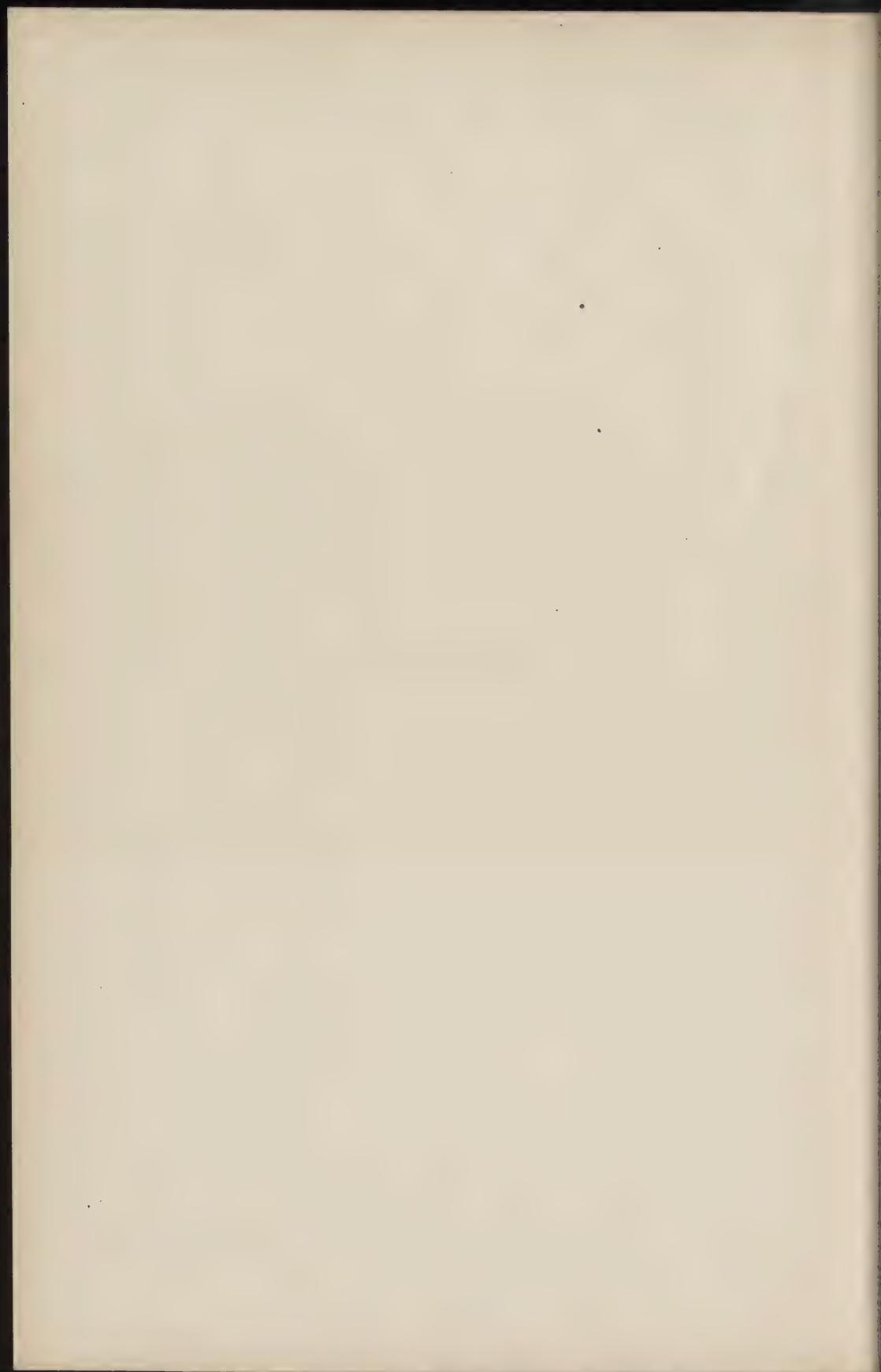
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WOOL



# WOOL

*The Raw Materials of the Woolen and Worsted Industries*

## CHAPTER I

### INTRODUCTION.—STRUCTURE, PROPERTIES AND CHARACTERISTICS OF WOOL

**1. Introduction.**—With the exception of the tropics, the world has always been wholly or partly dependent on wool for its clothing. Wool is the thick, wavy covering of the sheep. The sheep has always been one of the most valuable animals to mankind, furnishing both food and clothing. Breeding was originally directed to improve the fineness and weight of the fleece. Merinos were used for this purpose, but such types develop small carcasses and meat of poor quality. Demand for mutton, and the lack of profit in raising sheep only for their wool, has caused the cross-breeding of many types to suit environment and fancy, but with the object in view of founding the best type to give the greatest financial return to the sheep grower. These efforts have been successful, and the bulk of the sheep now bred, especially in the United States, are good mutton sheep first, with the quality of the wool produced a second consideration. With the high prices of wool since August, 1914, caused by the European War, breeding to improve the wool has received a great stimulus, especially in this country.

Aside from its other valuable properties, which will be considered directly, the chief value of wool lies in its ability to be spun into yarn. Other animals produce valuable textile fibers, a few of which are the goat, alpaca and camel, but for general purposes the fiber is not nearly so useful to mankind as the wool of the sheep. The character of fiber produced in most cases is not adapted to the many uses of wool, and furthermore, the number of animals producing such fibers is inadequate for the world's demands, and in many instances, only a small portion of the

world is adapted to the successful raising of these animals. It must be remembered that sheep are found, and in all civilized countries cultivated, in practically every inhabitable portion of the world. Nearly all animals have a coat of hair covering their bodies, and the dressed pelts with the hair or fur attached are of great value and use in the form of coats, muffs, neckpieces, gloves, robes, trimmings, etc., but these same fibers are of small value as a raw material for textiles, as they do not possess spinning properties.

It is a curious fact that the history of sheep is closely linked with that of man and the evolution of the one is involved in as deep and impenetrable mystery as the other. Whether the domestic sheep that roams our hills today has descended from the wild goat, or whether it is simply "sui generis," is a question which probably will never be decided. Naturalists are far from certain on the question, although for want of a determined theory, they have agreed that the *Ovis Ammon*, or *Moufflon* of Southern Europe and Northern Africa, were the progenitors of the *Ovis Aries*, or domestic sheep. This statement is the one generally accepted. It is a significant fact, however, that while all the varieties of domestic sheep known today present striking resemblances to each other, yet they have few if any characteristics in common with the *Ovis Ammon* or *Argali* of Asia and America, or *Ovis Musmon* or *Moufflon* of Southern Europe and Northern Africa.

As the wool of the Merino sheep has become an important element in the fabrics of the civilized world, it may be interesting and instructive to trace the history of these animals. While it is true that they are native of Spain, yet it is an historical fact that they were greatly improved by crossing with Italian sheep which were brought into Spain during the reign of the Emperor Claudius by an Italian named Columella. He removed from Tarentin in Italy to the southern part of Spain, bringing with him the first flock of these Italian sheep.

When Rome was in her glory, Pliny states that the sheep of Apulia, on the Bay of Naples, produced the best wool in the

world, while the wool of the Grecian sheep was second best, and that of the Milesians, an Asiatic race, was inferior to either of the others.

The Apulian or, as it was afterward called, the Tarentine sheep, produced a wool unequaled in its day. From birth, the sheep were given the most extravagant and finical care. To produce an exquisitely beautiful and wavy gloss to the wool, their bodies were protected by skins or other coverings. In order to examine the condition of the animal, it was frequently uncovered, the fleece drawn out, parted, and combed, to prevent matting, while it was frequently moistened with the finest oil and even with wine, and washed three or four times a year. The greatest care was bestowed on the sheep houses, constant washing and fumigation being considered imperative. When two years old, lambs were killed, it being thought that the fleece was then in its finest condition. This shows what extraordinary and pains-taking care was taken to produce clothing for the wealthy and refined Roman. With the advent of cotton and silk, however, better adapted as they were for clothing in sunny Italy, we find the Italians gradually neglecting their sheep, until finally they become more valuable for food than for wool.

It was from this carefully nurtured Apulian sheep that Columella selected the animals that he carried to Spain, subsequently crossing them with the native Spanish sheep, thus establishing a new variety, known today as Spanish Merinos.

**2. Early Sheep Husbandry in Spain.**—In A. D. 711, the Saracens established themselves in Spain. They were a prosperous people, living in barbaric splendor and reveling in luxuries unknown to the greater part of Europe. Among the industries which their extravagant living fostered was woolen manufacturing, which increased to such an extent that in the thirteenth century there were in the small town of Seville no fewer than sixteen thousand looms. A century later we find the woolen industry fully established in the northeastern part of Spain; and the fine cloths of Barcelona and Tortosa in Spain and of Per-



FIG. 1.—Flock of Sheep, New South Wales, Australia.  
*Reproduced by permission of The Philadelphia Commercial Museum*

pignon in France were renowned all over Europe for their excellence. In process of time, the Saracens were driven from their Spanish strongholds, and with them vanished the industries they had so liberally supported. It is said that Ferdinand V banished one hundred thousand artisans because they were Moors, and Philip III drove out three-quarters of a million, the majority of them being weavers and their families. The busy hum of Seville's sixteen thousand looms was forever silenced. Many times since Spain has endeavored to revive the woolen industry, but without success. Its glory departed with the enterprising if voluptuous Saracens.

Naturally the sheep husbandry suffered with the woolen industry, but not sufficiently to prevent the Spanish wool from being still the most valuable fine wool then known. Notwithstanding the mutations of fortune, they illustrated then as today the omnipotence of blood.

The Spanish sheep were of two kinds, stationary and migratory, or Estantes and Transhumantes. The stationary were of two breeds, one bearing a coarse wool about eight inches long, and the other a fine, short wool. There were also mixed and intermediate breeds. The habitat of the short-wooled sheep seems to have been in Estramadura and Andalusia, in the south of Spain. The term migratory, or Transhumantes, as applied to sheep, arose from the fact that the Spanish shepherds, desiring to produce the finest staples, drove their sheep from southern to northern pastures in the spring, returning them in the fall. The distance traveled was at least four hundred miles, and as the number of sheep was about ten million, it may be safely presumed that forty to fifty thousand men were employed in this semi-annual migration. In the middle of the fourteenth century, laws were enacted governing the migration, and a tribunal consisting of the chief proprietors of the flocks was established. Certain rights and privileges were granted, among them being the right to graze on all open and common land that lay in the way, and also the privilege of a path ninety yards wide through all enclosed and cultivated lands between Estramadura and Leon in the north

of Spain, or Soria in the northern central part. During a migration, all persons were prohibited from traveling this road. This law remained in full force until 1836, when the proprietors of flocks were forced to keep to the ordinary road. Each herd consisted of about ten thousand sheep, divided into sections of one thousand each. Each section had an overseer, and each herd a captain. The migration began in April, and the return was made late in September, from five to six weeks being required to accomplish the tedious journey. The Leonese sheep, having passed the winter at Estramadura, crossed the Tagus River at Almarez. Shortly after this passage, the shearing took place, delaying the journey only about a day.

Their method of shearing is interesting. The building in which it was done consisted of but two rooms, one of which was the sweating room, and the other the shearing room. In the sweating room were placed one thousand sheep, while one hundred and fifty to two hundred shearers awaited them in the adjoining room. By crowding the room with such large numbers, the sheep were thrown into a profuse perspiration, causing the yolk in the wool to run freely and making the wool easy to cut. The shearing finished; the journey was resumed.

As the object of the migration was to increase the fineness of the wool by maintaining constantly good pasture and equable temperature, it is interesting to note that authorities differ as to the value of the migration. Some claim that the stationary flocks in Spain and elsewhere produced equally good wool with the Merinos. However, it is certain that the Spanish Merino stands alone in the stability of its traits and breeding. No other breed of sheep has left so deep an imprint, and its introduction in other countries forms a most interesting and curious narrative.

**3. Influence of Spanish Merinos.**—In 1723 the Swedish Government imported a flock of Merino sheep. The sheep raisers viewed their advent with suspicion, and it was not until premiums for the best sheep and wool were offered by the government, that the absurd jealousy of the shepherds received a final death-blow.

Soon the flocks increased, and along with them came the manufacture of fine cloth.

France, in the seventeenth century, endeavored to introduce the pure breed of Merino. No less a personage than Colbert, the shrewd and far-seeing advisor of Louis XIV, brought several Merinos to France at his own expense. So great was the opposition, however, that he reluctantly abandoned the enterprise. In 1786 the French Government imported 376 ewes and lambs, placing them at Rambouillet, near Paris. The enterprise was an entire success, and the sheep thus introduced have exercised a commanding influence on the character of French wool. As France is separated from Spain by the Pyrenees, it is not at all surprising to find in southern France large numbers of cross-breed Merinos, and this influence has extended even to the central provinces.

Norway, about the middle of the eighteenth century, succeeded in introducing the Merino, much to the improvement of her flocks. About 1780, Denmark introduced a few Merino sheep, but mismanagement made their culture a failure. Some seventeen years later, however, the government brought in 300 Merinos, and so successful has been their culture, that the Danes now regularly export the finest quality of wool.

In 1765, the Elector of Saxony imported 300 sheep, and placed them on his own farm near Dresden. These were subsequently crossed with the Saxon sheep, much to the improvement of the Merino. Still the purity of the Merino was not obliterated, and although they became perfectly naturalized, the fleece of the Saxon sheep exceeded the Merino in fineness, so that the very word Saxony is instantly associated with the thought of super-excellent quality in wool and woolen materials.

In 1756 the Silesian sheep were introduced into Magdeburg, Prussia, and in 1768 the Saxony Merino, and 1778 pure Spanish Merino by M. Fink. The Prussian Government, after watching the experiment for a number of years, finally, in 1768, imported 300 sheep from Spain, and distributed them among the farmers, but indifference and ignorance killed them. M. Fink's enterprise,

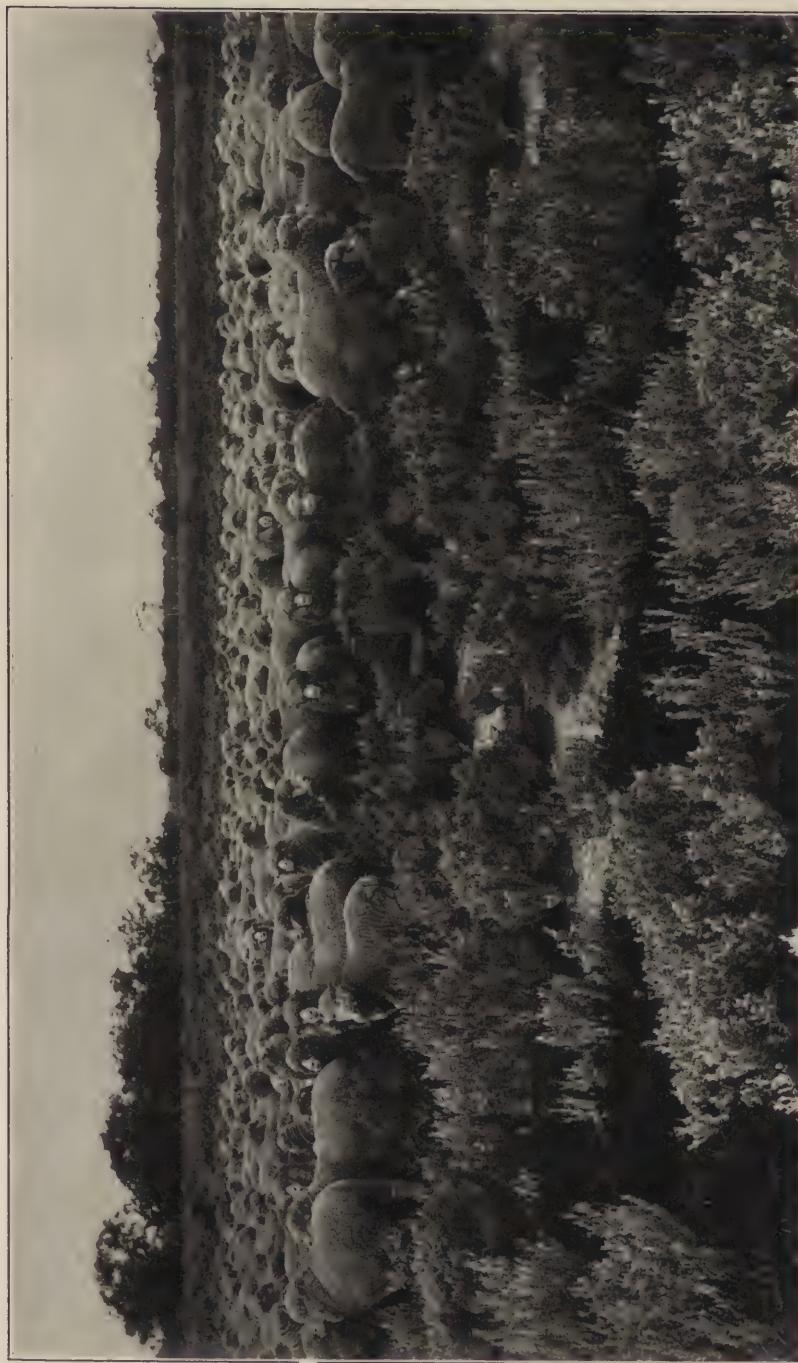


FIG. 2.—Australian Merino Ewes in Saltbush, New South Wales.

however, was successful, and soon the government employed him to buy 1000 of the choicest Merinos and establish the breed.

The Silesian sheep history is almost identical with that of Saxony. A native breed existed there which Count Von Magno improved by the introduction of the Merino, until he produced wool which today fairly rivals the Merino of Saxony in fineness.

The Empress Maria Theresa introduced the Merino into Hungary in 1775, and with such success that today the Hungarian wool is a rival to the Spanish Merino.

Hanover followed in the Merino improvement, and in every part of Germany the Spanish Merino has improved the fleece. In 1789 the Spanish Merinos were taken to Belgium and Holland.

In 1791 England imported a number of Spanish sheep, and the character of the wool seemed unchanged by the transfer. Merino sheep soon sold at enormous prices. In 1811 there was formed the Merino Society, with fifty-four vice-presidents. Premiums were offered, and, as it afterward proved, this very action sounded the death-knell of the Merino sheep in England. Not only were premiums offered for the pure Merino, but for the crossbreeds, and it was found that under the system of artificial breeding there carried on, in order to bring sheep early and profitably into the market, something more was needed than a wool producer. The Merino is undeniably great as a fleece producer, but it matures late and fattens slowly. It was proven that mutton sheep more than divided the honors with the fleece producer, and that the combination of carcass and wool which produces the greatest financial return was the best for a country like England.

The most remarkable event in the history of Merino sheep was its introduction in 1810 into Australia. For twelve years the colonists were at work improving the native breed, and had accomplished wonders. Finally they decided to try the influence of the Merino, and the cross was greatly to their advantage. In three years, the number of sheep almost doubled, and in twenty-eight years had increased almost an hundredfold. The sheep

itself improved, the climate and soil both favoring it; and soon the wool became famous throughout the world.

In 1802, Dr. David Humphreys, of Derby, Connecticut, returned from Madrid, where he had been acting as American ambassador since 1789. He brought with him a flock of Merino sheep. Prior to Humphreys' importation, a few of these sheep were imported; but only one animal became identified with our flocks, the remainder having been killed for food.

In 1809 and 1910, 4000 Merino sheep were imported into this country. Sheep were introduced at Jamestown, Va., from England in 1609, and in 1633 they were first brought to Boston; but these were the ordinary English breed, being a coarse variety of the Leicester.

South America and South Africa have both successfully introduced the Merino, and produce large quantities of Merino wools.

The Merino sheep has left its imprint upon nearly all the European countries, North and South America, Australia and South Africa. In Asia, it has made but little progress, for here the prevailing variety is quite a different animal. The fat rump and broad-tailed sheep abound, more especially the latter, and there is every reason to suppose that little change in the animal has taken place for centuries. Syria was the central point around which congregated the early flockmasters, and here the fat-tailed sheep are found in abundance. They are so termed from a great accumulation of fat in the tail, the weight of this appendage alone being about one-third the weight of the whole sheep. In some of the sheep the fat covers the haunches; others have two large lobes of fat at the side of the tail. For the most part the wools from them are coarse, and form a very considerable portion of what is called carpet wool. Usually these carpet wools are more or less a product of mountain districts or desert regions, and go hand in hand with an inferior civilization. They are the class of wools raised by the nomads of Asia, by the fellahs of Egypt, and by the northern Russians. The sheep are all susceptible of improvement to a great degree, as is shown in the Natal and Cape wools of South Africa.

**4. Ancient Breeds and Original Types of Sheep.**—It is an impossibility to give an absolutely correct list of the original breeds of sheep. Many varieties of wool sheep especially were migratory and became crossed in the course of time, while small bands of other migratory sheep became located in fresh surroundings, rapidly changed, and finally developed new types and different characteristics. In the early stages of civilization sheep were taken from one country to another by nomads and exchanged for other commodities. Different climatic conditions and changed circumstances again produced fresh types. No animal in existence has the power to adapt itself to local conditions like the sheep, and no animal is so readily influenced by environment. Under these circumstances it is impossible to get right back to the original breeds, and the very best authorities can only give us a vague idea of the different breeds of sheep existing when they were first partially domesticated by primitive civilization.

Archer, who made an exhaustive study of this subject, gives thirty-two varieties, of which four are inhabitants of Europe, fifteen of Asia, eleven of Africa and two of America. Bowman compiled a classified list of these thirty-two varieties, and it is generally regarded as the best list of its kind. Other authorities have recently made a more exhaustive study of distinct breeds and original types, and they make a wider division. These additional varieties are included in the territorially classified list given below and brings the total number up to forty-four.

Some of these ancient breeds have become quite extinct without leaving any trace of relationship behind them, while others have undergone such changes during the past century that the original type is now unrecognizable. These numerous changed types are chiefly confined to Eastern Europe, and are now recognized as distinct breeds with a separate classification. It is estimated that about twenty of the ancient breeds can still be found in Asia and Northern Africa, but the original types have undoubtedly undergone considerable change.

ANCIENT BREEDS AND ORIGINAL TYPES OF SHEEP  
(Territorially classified)

I. EUROPE

1. The Spanish Merino Sheep. (*Ovis Hispaniensis.*)
2. The Common Sheep. (*Ovis Rusticus.*)
3. The Domestic Sheep. (*Ovis Aries.*)
4. The Crimean Sheep. (*Ovis Congicaudatus.*)
5. The Musmon Sheep. (*Ovis Musimon.*)
6. The Cretan Sheep. (*Ovis Strepsiceros.*)
7. The Dwarf Sheep of Scandinavia.
8. The Iceland, or "Double Fleeced" Sheep.

II. ASIA.

1. Hooniah, or Black-faced Sheep of Thibet.
2. Cago, or Tame Sheep of Cabul. (*Ovis Cagia.*)
3. Nepal Sheep. (*Ovis Selingia.*)
4. Curumbar, or Mysore Sheep.
5. Garar, or Indian Sheep.
6. Dykhum, or Deccan Sheep.
7. Morvant de la Chine, or Chinese Sheep.
8. Shaymbair, or Northern Mysore Sheep.
9. Broad-tailed Sheep. (*Ovis Laticaudatus.*)
10. Many-horned Sheep. (*Ovis Polyceratus.*)
11. Pucha, or Hindostan Dumba Sheep.
12. The Tartary Sheep.
13. The Javanese Sheep.
14. Borwall Sheep. (*Ovis Barual.*)
15. Short-tailed Sheep of Northern Russia.
16. Argali Sheep. (*Ovis Ammon.*)
17. The Pigmy Sheep of Siberia.

III. AFRICA.

1. Smooth-haired Sheep. (*Ovis Ethiopicus.*)
2. African Sheep. (*Ovis Guinensis.*)
3. Guinea Sheep. (*Ovis Ammon Guinensis.*)
4. Zeylan Sheep.
5. Fezzan Sheep.
6. Congo Sheep. (*Ovis Aries Congensis.*)
7. Angola Sheep. (*Ovis Aries Angolensis.*)
8. Zenu, or Goitred Sheep. (*Ovis Aries Steatinorius.*)
9. Madagascar Sheep.
10. Bearded Sheep of West Africa.
11. The Fat-rumped Sheep of Egypt.
12. The Fat-tailed Sheep of South Africa.
13. Morocco Sheep. (*Ovis Aries Numidæ.*)
14. The Tunis, or Pendulous-eared Sheep.
15. The Somali, or "Half-black" Sheep.
16. The Aoudad, or "Intermediate." (*Ammontragus Tragelaphus.*)

IV. AMERICA.

1. Brazilian Sheep.
2. West Indian Sheep of Jamaica.
3. The Big Horn Sheep of the Rockies. (*Ovis Montana.*)

## PHYSIOLOGY AND STRUCTURE

5. **Physiology of the Wool Fiber.**—Wool, in common with all kinds of hair, is a growth originating in the skin or cuticle of the vertebrate animals, and is similar in its origin and general composition to the various other skin tissues to be found in animals, such as horn, nails, feathers, etc. Wool is an organized structure growing from the root situated in the dermis or middle layer of the skin, its ultimate physical elements being several series of animal cells of different forms and properties.

The root of the wool fiber is termed the hair follicle; it is a gland which secretes a lymph-like liquid, from which the hair is gradually developed by the process of growth.\* The hair follicle also secretes an oil, which is supplied to the fiber during its growth and serves the purpose of lubricating its several parts, giving it pliability and elasticity.

In conjunction with the hair follicle there also occur in the skin numerous sebaceous glands which secrete a fatty or waxy substance, commonly known as wool-fat. This substance gradually exudes from the glands and coats the surface of the wool in rather a considerable amount. It affords a protective coating to the fiber, which serves to preserve the latter from mechanical injury during its growth, and also prevents the several fibers from becoming matted and felted together. In the preparation of wool for manufacture,



FIG. 3.  
Section of Skin.  
25 Diameters.

- A—Cuticle.
- B—Rete mucosum.
- C—Papillary layer.
- D—Corium.
- E—Subcutaneous adipose cells.
- F and G—Sudoriparous glands.
- H and I—Hair follicles.

\* If the form of a hair is considered, it will be noticed at the base to have an egg-shaped swelling or root, and just above this a rather contracted portion, or neck. The hair attains its greatest breadth usually in its uppermost third. The majority of hairs shows considerable differences in appearance when examined along their length (Höhnle).

this fatty covering has to be removed, the operation constituting the ordinary process of wool scouring, the object being to leave the fiber clean and free from adhering substances. There is also a wool-oil which is contained in the cells of the fiber itself, and is a true constituent of its substance. This oil should not be removed, as its removal causes the fiber to lose much of its elasticity and resiliency. The oil amounts to probably about 1 per cent. of the total weight of the fiber, whereas the external fatty matters amount on an average to about 30 per cent.

**6. Structure of the Wool Fiber.**—Morphologically considered, the wool fiber consists of three distinct portions:

- The medulla; a cellular marrow, which frequently contains more or less pigment matter to which the wool owes its color.
- The cortex; this is the name of the substance surrounding the medulla and is composed of many elongated conical tissues. This is the portion of the fiber which furnishes most of the strength and elasticity.

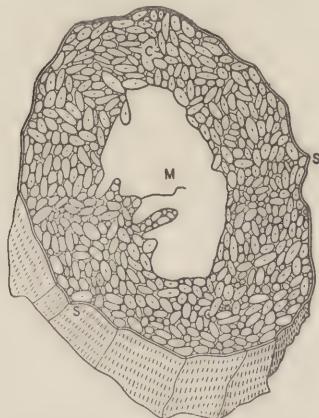


FIG. 4.  
Diagram Showing Structure of Wool Fiber.

M—Medulla or marrow.  
C—Cortical cells.  
S—Scales or epidermis.

c. The epidermis; this is the outside or surface of the fiber and consists of flattened cells or scales, the ends of which generally overlap each other, and project outward, causing the edge of the fiber to present a serrated appearance. This scaly covering gives the fiber its quality of rigidity and resistance, and helps to felt together on rubbing against one another by the interlocking of the projecting edges of the scales.

**7. Microscopy of Wool.**—The microscopic appearance of wool

is sufficiently characteristic to distinguish it from all other fibers. Under moderately low power of magnification the epidermal

scale on the surface of the fiber can be readily discerned. The scales are more or less translucent in appearance and permit of the under cortical layer being seen through them. The exact nature, structure and arrangement of the scales differ considerably with different varieties of wool. In fine Merino wools, for instance, the individual scales are in the form of cylindrical cusps, one somewhat overlapping the other; that is to say, a single scale completely surrounds the entire fiber. In some varieties of wool, on the other hand, two or more scales occur in the circumference of the fiber. In some cases the edges of the scales are smooth and straight, and this appears to be especially characteristic of fine qualities of wool; the coarser species, on the other hand, possess scales having serrated, wavy edges. Usually such scales are much broader than they are long and are very thin. The length of the free or projecting edge of the scale is also a very variable factor; in some wools the scale is free from the body of the fiber for about one-third of the length of the former, and in consequence the scale protrudes to a considerable extent; such wool would be eminently suitable for the preparation of material which requires to be much felted. In other wools the free edge of the scale amounts to almost nothing, and the separate members fit down on one another closely, and are arranged like a series of plates. Wools of this class are more hairlike in texture, being stiffer and straighter, and not capable of being readily felted.

In some varieties of wool fiber the scales have no free edge at all, but the sides fit tightly together with apparently no over-



FIG. 5.

Typical Wool Fiber.

250 Diameters.

Showing the pointed and serrated edges of the epidermal scales when treated with caustic soda.

lapping; in such fibers the surfaces of the scales are also more or less concave. This structure only occurs with thick, coarse varieties of wool. Frequently at the ends of the wool fiber, where the natural point is still preserved (as in the case of lamb's wool from fleeces which have not been previously sheared), the scales are more or less rubbed off and the under cortical layer becomes exposed, this appearance is quite characteristic of certain wools. In diseased fibers the epidermal scales may also be lacking in places, causing such fibers to be very weak at these points.

In most varieties of wools the scales of the epidermis may be readily observed even under rather low powers of magnification, while under high powers the individual scales may be seen overlapping one another like shingles on a roof, and showing pointed, thickened protruberances at the edges. When the fiber becomes more hairlike in nature, such as mohair, alpaca, camel-hair, etc., it is more difficult to observe the individual scales, as these fuse together to a greater or lesser degree, until the true hair fiber is reached, which exhibits scarcely any markings of scales at all under ordinary conditions.

#### PROPERTIES AND CHARACTERISTICS

**8. Properties and Characteristics.**—To the seeker of wool for textile manufacturing purposes certain well-defined properties or characteristics must be apparent in the material, all of which go directly to increase or diminish its value and usefulness. Prominent among these properties are the following: Fineness or diameter of fiber, length of fiber, strength, elasticity, softness and pliability, color, luster, felting and shrinking, working qualities.

**9. Fineness or Diameter of Fiber.**—Fineness or diameter of wool fiber is a property which has always been considered of prime importance when judging the quality of wool. In fact, fineness is of such great importance in determining the value of wool, that one of the first steps in the preparation of wool for sale is to grade it according to fineness, as well as uniformity of fineness, throughout the fleece. It is well to remember, however,

when judging the fleece from any breed of sheep, that there is a degree of fineness, or diameter of fiber, that belongs to that particular breed of sheep, and that the finest wool found upon it may, in comparison, be considered coarse when compared with really fine wool. So, between the finest wools grown, with an average diameter of  $1/890$  inch and the thick-haired wools with an average of  $1/250$  inch, there are numerous gradations in fineness of diameter of fiber.

The really fine diametered wools always tend to be shorter in length than the coarser ones, and the extremely fine wools are very short. At the present time, however, there is an apparent scarcity of these extremely fine wools throughout the world. This condition is said to be brought about first, by the limited demand on the part of the manufacturing trade, and second, by economic reasons controlling the wool-growing industry; and in consequence, fineness, as we primarily know it, is becoming secondary, and length of fiber, with a more or less limited degree of fineness, has become of first importance.

*Uniformity of Fineness.*—The ideal condition as regards uniformity of fineness would be, that the wool should be equally fine in every part of the fleece. This condition is far from being realized. As a matter of fact, the diameter or fineness of fiber is quite variable even in the same fleece, and may range from .0018 to .004 inches. In the most uniform fleeces the wool on the shoulders and neck is much finer than on the hind quarters, but there should be as little variation as possible. Well-bred Merinos are noted as having least variation in this respect.

A second uniformity of fineness is that the fibers growing side by side, or the fibers in any given lock, so to speak, should be as nearly as possible of the same diameter. There is in this respect a great variation in wool. Some of the wools from the better bred sheep do not vary in diameter of fiber more than fifty per cent. from the finest to the coarsest, while from the unimproved sheep the coarsest fibers may be five or six times as thick as the fine ones. The fleece of a well-bred sheep that has an even and

distinct crimp will generally be found to be of superior uniformity of fineness in all respects, including that within the lock.

**10. Length of Fiber.**—In length, the wool fiber varies between large limits, depending almost wholly on the breeding and the quality of sheep. The usual market range is from one to eight inches, some coarse wools, such as braid and carpet, running over twelve inches in length. There is, however, a variation in length in different parts of the same fleece. Since the introduction and popularity of fine worsted for both men's and women's wear, length is much more important in fine wool than it was heretofore. As a matter of fact, length was of comparatively little importance when the Merino breed of sheep was first introduced into the United States, as is testified by the fact that growers of the then fine wools, in describing the wools they grew, pointed with pride to the fact that their product was not over one inch in length.

For practical purposes, the important thing for the manufacturer is the total length of the fiber, with the so-called wave or crimp it contains, taken out of it. The length of wool is measured by the length of staples; that is, of the locks of wool as they come from fleece, without stretching. The difference between the length of staple and the length of fiber is in waviness or crimp; so a short staple wool with much crimp is to be preferred to one with a longer staple in which the fibers are lacking in crimp.

*Uniformity in Length.*—Uniformity of length of a fiber in a fleece is quite as important as uniformity in fineness. A fleece that is uniform in length will show little variation from shoulder to britch. This ideal, however, is never fully realized, as wool from the fleece that has not been artificially trimmed is longer on the front and the middle of the fleece than on the britch and around the edges. But the fleece that is most uniform in length will have the fibers that lay together in the lock of any given area, all of the same length.

This condition is more usually found in healthy, well-bred and well-conditioned sheep than others. The main deficiencies in

this respect are (a) long-fibered fleece with an undergrowth of fine wool; (b) wool of average length and fineness with an undergrowth of shorter wool. The first is a common condition of many of the native and unimproved breeds of sheep.

**11. Strength.**—Wool fibers possess fairly good strength, but are inferior in this respect to nearly all other textile fibers. Wool, to be useful as a textile fiber, must have strength. That is to say, the fibers must be able to undergo a considerable stress without breaking; the stronger the wool, other properties being equal, the stronger the product out of which it is made, would naturally be.

And wool that is to be processed into a worsted yarn must be moderately strong, for in going through the various operations required the individual fibers are subjected to rather severe strains, and if the wool is weak the fibers will break up and the proportion of waste is increased in ratio. So it follows that wools selected for the making of worsted yarns, must possess good strength as well as sufficient length.

*Defects of Strength.*—There are two kinds of defects causing lack of strength. One is called tender wool; that is, it is weak throughout the fiber. The other is called wool with a break, or wool having a weak place; that is, when a lock is stretched, it breaks squarely across, as if during the growth of the fleece something had happened to the health of the sheep that caused the same relative part of each fiber that grew during that period to be weaker than the part that grew before and the part that grew afterward. (See illustration on page 38).

*Causes of Weakness.*—There are many causes which may produce a weak place in the fiber; starvation during a severe storm; overfeeding with highly concentrated food; the change from cold weather to warmer weather with succulent and green feed; sickness of any kind, especially if accompanied by fever. At times the break is so pronounced that the fleece actually drops off of its own accord or is blown off by the wind or pulled off by the

brush. It is not unusual to find in flocks that are being fed heavily with corn a few sheep that have lost their fleeces and are as pink as new-born mice.

*Strongest Wool.*—Wool from southern Ohio and the bordering counties of Pennsylvania and West Virginia are said to be the strongest in the world. Some territory wools, such as Wyoming and the surrounding range States, grow almost as strong a wool as Ohio, except for the weathered area on the back of the fleece and for the occasional bad break, due to severe storms or conditions that cause the sheep to be in poor health.

**12. Elasticity.**—This is important in wool. It is one of the properties that make wool superior to the vegetable fibers, such as cotton and linen. It may be defined as the property that causes the fiber to come back to its original shape after it has been stretched or bent or flattened under pressure. Nearly all wool from the improved breeds of sheep is sufficiently supplied with this property.

The fine wools, in particular, tend to be the most elastic. Elasticity is generally measured by the percentage of elongation that the fiber can undergo before it breaks. This is a very fair measure, but the more practical method is to measure the per cent. of elongation that the fiber would undergo without losing the power to resume its original length. Twenty-five per cent. is about the average of good live wool.

**13. Softness and Pliability.**—Softness and pliability are properties which vary considerably in wool, and are dependent largely upon breed and grade. Factors affecting this property are, in addition to breeding and grade of wool, care which the sheep have received, together with soil and climatic conditions. Exposure to weather seems to also have something to do with it. But, in part, it seems to be quite as much a lack of care as anything else when selecting for breeding purposes.

The amount of pliability depends fundamentally upon the arrangement of scales upon the outer surfaces of the fiber. For

a soft, pliable fiber, the scales should fit over one another loosely, and at the same time should be very numerous. These conditions are to be found in fine wools such as the Merino type. Fine Australian Merino wools are much valued on account of these properties. But the softness and downy nature of these wools seem to be attained to some extent at the expense of strength.

Soft and pliable wool can be spun into finer yarns than would be secured with wool of the same fineness that is not soft. One of the principal values of softness in wool is that products produced therefrom have a more attractive appearance and handle, and are consequently much preferred by the purchasing public.

**14. Color.**—Color is an important quality of wool. What is really meant by color in most cases is tint. Although wool appears to be white, it is really cream color, having a brownish or yellowish tint, and when we say a wool is white, or bright, it means that it is comparatively free from this yellowish tint. The darker colored wools, which range from gray to brown or black, are not as valuable as the white wools, but there is a small percentage of such fleeces in nearly all flocks of improved sheep. A color defect which amounts to an impurity is a mixture of black fibers through a white fleece. The fleece which has this defect, if only to a very slight extent, cannot be accepted as white fleece, because the black fibers will show in white goods and goods that are dyed a delicate shade.

The quantity of colored wools produced is, however, comparatively small, and, while they are in demand in certain fabrics, they usually are graded from 10 to 20 per cent. less than the white fleece of equal quality.

**15. Luster.**—Brightness is a property of fine wools, while luster is peculiarly a property of the coarser, longer wools. Wools that are lustrous make smooth and shining yarns and, in turn, lustrous cloth. The Lincolns and Leicesters are especially lustrous. Luster may be described as the property by which wool reflects light something after the manner of spun glass. It is most perfect

in good mohair. Brightness is the property by which wool reflects the light somewhat as powdered glass does.

**16. Felting and Shrinking.**—Felting is a most important property, and wool is the only important textile fiber which possesses this property to any great extent. However, not all wools possess the property to the same degree. This felting property in wool is dependent in a very large measure on the nature and number of scales or serrations on the surface of the fibers. The more the free edges of these scales protrude from the surface of the fiber, the more easily the wool will felt. As a rule, however, the finer and more serrated the wool, the greater its felting property. Fine Texas, Ohio, Pennsylvania, Virginia and similar Merino type wools are especially valuable on this account.

Manufacturers of woolen goods avail themselves of this property to a marked degree in finishing their fabrics by what is commonly known as the "Fulling" process. Some woolen fabrics are shrunken and reduced in length 30 to 40 per cent., and as high as 50 per cent. in width. The majority, however, are laid out to shrink from 15 to 25 per cent.

In order to take advantage of this felting property in wool, three distinct agencies are required—moisture, pressure and heat.

The moisture and pressure are supplied; the heat, however, must be generated (in case of woolen cloth) within the material itself, brought about by causing the material to friction, as it repeatedly passes through the fulling process. The degree of heat generated is a most important factor; too much heat is injurious, and too little heat defeats the object sought.

The pressure is supplied by heavily weighted revolving rolls forming a part of the so-called fulling mill. The serrated saw-like edges of the fibers having become soft and pliable, come in contact and fit into each, and lock fast under the pressure of these revolving rolls.

The moisture is supplied by means of an alkaline soap solution, with just enough alkaline content to act with the heat generated in such a manner as to cause the hardened scales (which

were originally of a gelatinous membrane nature), not only to become softened up, and pliable, but, in addition, will also loosen up and hold in suspension the fatty matter or suint, lying directly under them.

The absence of sufficient oil, due to the age of the sheep, sickness, or low vitality, oftentimes causes wool to felt on the sheep's back, particularly that portion nearest the skin. Such fleeces are known as cotted or cotty fleeces. The arrangement of all fibers in the fleece is naturally in one direction. As they grow from root to tip all the scales are pointed in the same general direction, and if the fibers are sufficiently supplied with yoke there is little chance for the scales on various fibers to become interlocked.

**17. Waviness and Crimp.**—This condition is caused by the uneven growth and arrangement of the cortical cells, which cause the fiber to contract and bend. Waviness is more pronounced and called crimp in fine wools. It is usually totally absent in coarse wool fibers, and if present the waves are long and irregular. The nearer the wool fiber approaches the structure of ordinary hair the more infrequent and irregular become the waves. It should be remembered that this waviness or crimp is valuable in spinning and increases the elasticity of the yarns as well as the fabric, if present to any considerable extent.

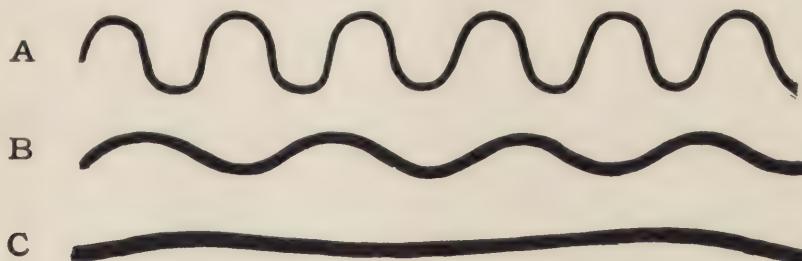


FIG. 6.—Contrast between Crimp and Waviness.  
A—XX Wool; B— $\frac{1}{4}$  Blood Wool; C—Mohair.

**18. Working Properties.**—These are properties which are not very easily described or their presence or absence easily detected

in wool. But it will be found that wool which is superior with respect to the properties already enumerated: length, uniformity, strength, softness, etc., will be found to have good working qualities. On the other hand, wool that has been exposed to the weather until it is rough and dry and tangled by the wind will be found to be deficient. Wool that is open and free in the lock and has an even crimp will be found to have good working qualities.

**19. Kempy Wool.**—Frequently, through disease or other natural causes, the medulla of the wool fiber is imperfectly developed, or the scales of the epidermis are cemented together, in consequence of which the wool will not absorb solutions readily, and hence will not be dyed (or mordanted) at all, or only slightly. These fibers, which are known as kems, will occur through the mass of the wool as undyed streaks, and will give the yarn or fabric a speckled appearance. Kempy wool is said to be due to undue exposure of the sheep and to bad feeding. It is also more noticeable in wools grown in mountainous regions. Kempy wool should not be used in fabrics intended to be dyed a solid color. For blankets, Scotch tweeds, horse-rugs, mantle cloth, and the like, the occurrence of kempy fibers in the wool is not an especial drawback. Not only may this condition, however, be brought about by natural causes, but it may at times be the result of improper manipulation during manufacturing processes. According to Bowman, kems have a dense appearance, the cellular character being entirely obliterated, the fiber assuming the appearance of an ivory rod without any internal structure being visible. Kempy fibers are always much thicker than the rest of the wool among which they grow, and the medulla or central portion of the kemp is quite thick.

**20. Chemical Composition.**—The chemical composition of wool varies slightly with the different breeds of sheep, and the other factors previously mentioned as affecting the growth and character of the wool on the sheep's back. The following are average percentages: Carbon, 50 per cent.; hydrogen, 7 per cent.;

nitrogen, 18 per cent.; oxygen, 22 per cent., and sulphur, 3 per cent.

**21. Action of Acids and Alkalies.**—Wool is unaffected by dilute acids and has a great affinity for them. This property is utilized in the dyeing of acid colors. Being an animal fiber, wool is tendered and weakened by alkalies, and when concentrated they completely dissolve it.

**22. Bleaching.**—The common method of bleaching wool is to subject the scoured wool, yarn or fabric in a damp condition to the action of sulphur dioxide gas. The stock, yarn or fabric is arranged in a separate, comparatively air-tight building, so that the fumes will attack all parts equally. Sulphur is slowly burned in an iron pot giving off sulphur dioxide gas. This takes from one to two hours, according to the quantity of sulphur used. The door is then opened, and after the fumes have escaped, the wool is removed. Another method using the same agent is to pass the wool through a sulphurous acid bath. These bleaches are not permanent, and in time the natural color returns. Washing with soap quickly destroys the results obtained from the sulphur bleaching methods, and restores the original color.

The only true wool bleaches are the hydrogen peroxide and sodium peroxide bleaches. These bleaches are expensive but permanent, and are fast supplanting the "stoving" or sulphur bleach, and are used for bleaching the better grades of woolen and worsted fabrics where white is desired.

**23. Dyeing.**—Wool has a great affinity for dyestuffs and is readily dyed. The three most common conditions of wool for dyeing are stock or fiber, skein, and piece. The removal of all grease and oil by scouring or degreasing is necessary before dyeing.

**24. Action of Heat.**—Heat causes the wool fiber to expand. High temperatures tender wool, making it harsh and brittle. Ex-

cessive heat decomposes wool. Wool is completely denatured and disorganized when heated to a temperature of 130 degrees C. with water under pressure; and on drying can be rubbed into a fine powder.

**25. Conductor of Heat and Electricity.**—Wool is a very poor conductor of heat and electricity, but it is a good generator of electricity. These properties make wool so well adapted for clothing where warmth is desired, as the wool, being a poor conductor of heat, prevents the heat given off by the body escaping quickly.

**26. Grease and Foreign Matter.**—The grease present on the wool fibers serves as a protection to the fibers from felting while in the growing fleece. It is secreted by the fatty glands around the hair-follicle in the skin. The value of this natural grease to the wool is well illustrated by its absence in what are known as "cotted fleeces," where the fibers are matted together so badly that the wool is of little value. This is caused by insufficient natural grease, due to the sheep being sick or very old. Cotted fleeces are seldom found on sheep which run the ranges of the west, as they are more hardy and possess greater vitality than housed sheep.

"Suint," or dried-up perspiration, is also present on the wool fibers along with the natural grease or "yolk." Suint consists of potash salts, and is soluble in water, whereas the grease is insoluble. Suint approximates 15 per cent. of the total weight of grease wool.

"Foreign matter," such as dirt, sand, straw, burrs, twigs, manure, etc., becomes readily attached to the grease, and most of it carries along with the fleece until scoured out. The vegetable matter is removed by the burr-picker or carbonizing.

The total amount of grease, including suint and foreign matter, present in a fleece of wool depends upon the breed of the sheep, grade of wool, soil, care given the sheep, and climatic conditions. The "shrinkage" or loss in scouring will vary from 20 per cent. to

75 per cent. In other words, in scouring 100 pounds of grease wool, there would be from 20 to 75 per cent. loss. For example, if a 100-pound lot lost 60 per cent. in scouring, then only 40 pounds of clean wool were obtained.

**27. Methods of Removing Grease.**—The scouring bath contains soap and soda ash, and frequently ammonium or ammonium carbonate. The bath should not be heated to any higher temperature than the hand will stand, and the wool should be carefully handled while in the scouring bath or it will become felted and matted. Following the scouring bath, the wool is rinsed in a bath of cold water and then dried. This is the most common method and generally used.

Some large mills have abandoned the method just described, and have installed degreasing plants. The degreasing process is a solvent method, and reclaims the valuable grease and potash salts, both of which are a total loss in the ordinary scouring process. The wool is subjected to the action of petroleum-naphtha, which dissolves the wool fat, and then to a water bath, which removes the potash salts. By subsequently volatilizing the petroleum-naphtha, the wool fat or degras is reclaimed. The potash salts are recovered from the water bath. Expensive machinery and the use of dangerous materials are the objections to the degreasing process. The greater operating expense is overshadowed by the receipts from the reclaimed wool fat and potash salts.

**28. Moths.**—Wool in all conditions, greasy or scoured, is the prey of moths, which deposit their eggs on the wool, so that when the worms are hatched they will have tasty nourishment right at hand. One of the most common preventives is camphor.

**29. Mildew.**—Mildew is a fungoid growth, which readily develops in wool, where heat and excessive moisture are present, and the wool is not accessible to plenty of fresh air.

**30. Moisture or Hygroscopic Quality.**—Wool is the most hygroscopic textile fiber; the amount of moisture it will hold varies

with the humidity and temperature of the surrounding atmosphere. Under average conditions, wool will contain from 12 to 17 per cent. moisture, but if stored in a damp warehouse for a considerable length of time it will take on as high as 30 per cent. moisture. This feature is sometimes utilized by unscrupulous wool dealers. To ascertain the actual amount of moisture present, conditioning houses have been established for finding the true amount of fiber and moisture. A certain percentage of moisture, known as "regain," is then added to the bone-dry weight of the fiber to get the proper selling weight of the wool under consideration. The amount of regain varies with the established custom in different countries and sections of the same country; the most common allowance in the United States is 15 per cent.

## CHAPTER II

### CLASSES OF FLEECE WOOL.

**31. Classification.**—Practically all fleece wools can be classified in one of the four following divisions: 1—Merino. 2—British. 3—Crossbreds. 4—Carpet Wools.

There are about two hundred different breeds of sheep in the world, but their fleeces can all be classified under the four divisions given above. The breed of the sheep influences the character of the wool grown on it, and governs to a large extent the length and diameter of the fibers, and also the other points to be considered, such as strength, elasticity, shrinkage, color, luster and waviness.

**32. Carding and Combing Wools.**—In all four divisions as made above, both clothing or carding and combing wools are to be found. In fact, one mill would often use a certain wool for a woolen yarn, and another mill would use the same identical wool for a worsted yarn, and both mills might be selecting the most appropriate stock for the fabrics in view. The dividing line in the trade between carding and combing wools is from 2 to 2.5 inches. The wool classed under the British and Crossbred divisions is principally long and medium staple combing wool. Comparatively short wools are now successfully combed, and many wools which were formerly only suitable for carding are now eagerly sought for combing purposes. This change was brought about by the many improvements in the Noble or circular comb, and later the introduction of the French or Heilman comb. The original Lister or square nip comb is still necessary for coarse, long-stapled stock, and usually operates on staple ranging from 8 to 12 inches. The Noble comb is best adapted for handling fine and medium staple wools running from 2.5 to 8 inches in length. Staple under 2.5 inches is treated by the French comb, and is known as “baby combing” wool. Wools over 12 inches in length are “prepared” and not combed. The process of “pre-

paring" is to allow a coarse gill box to straighten out the tangled fibers. The "noils," or short fibers under a desired length, are not taken out in this system. The removal of the short fibers is not nearly so important a factor to a satisfactory worsted yarn

made of these very long wools, as is the case with the shorter ones, owing to such wools containing a smaller percentage of short fiber, and also to the fact that there is less contrast in length between the long and short fibers in these unusually long wools.



FIG. 7.—Tops of Different Lengths.

### 33. Old Classification.

—Some years ago, when only the square nip comb was available, all wools could easily be divided into three classes according to their availability for processing. These divisions were: First, clothing or carding; second, combing, and third, carpet. This method of dividing wools is also known as the "blood" classification. In the first class were placed all full-blooded Merino wools, and crossbred wools



FIG. 8.—Combing and Clothing Wools.

showing a fair percentage of Merino blood. The second class included the various British breeds, such as the Southdown, Shropshire, Dorset Horn, Oxford Down, Yorkshire, Hampshire, Cheviot, Leicester, Lincoln and Cotswold. None of these wools were less than 5 or 6 inches in length. The carpet wools included all wools inferior to those placed in the first and second classes, and, as the name signifies, they were used in the manufacture of carpets. These carpet wools vary widely in fineness, length, strength, color and working properties. Most of this wool comes from native uncultivated sheep of semi-civilized parts of the world, such as China, Turkey, Persia, Arabia, Asia Minor, Turkestan, Russia, the Balkan States, India, the East Indies and Northern Africa. Another source of supply for carpet wools is the lowest sorts from the fleeces of the first two classes. Certain grades of carpet wools are also known in the trade as "colorado" wool.

**34. Merino Types.**—The Spanish Merino sheep was the original Merino, and the foundation of the various types of Merino sheep now found in the principal wool-growing countries of the world. Owing to changes in climate and soil, the original Merino from Spain developed into other distinctive types. These changes in type have also been brought about by breeding the full-blooded Merino sheep with British and native breeds. The principal Merino breeds of today are the Spanish, Rambouillet or French, Saxony, Silesian, Australian, American, South American and Cape of Good Hope or South African.

The American Merino has been bred from the French more than the Spanish Merino, so that the body of the sheep is larger than the latter and the mutton improved. Merino sheep are usually bred and raised for the quality and value of their wool, mutton being an after consideration. In the first part of the nineteenth century, American Merinos were bred from the Spanish stock. The type developed many folds and wrinkles of flesh on the body, which increased the fiber-bearing surface. The fleeces of such sheep often amounted to 20 per cent. of the total weight of the live sheep. With the introduction of machine shearing

and the increasing importance of mutton as a factor in sheep growing, this type became unpopular, and the breeders took up the French Merino. This new type of American Merino is comparatively free from wrinkles, and the sheep are much larger and heavier. Merino sheep are strong and hardy, and quickly adapt themselves to changing environments.



FIG. 9.—Delaine Merinos, Class C.

Merino sheep are divided into three groups, A, B and C, on the basis of the presence or lack of wrinkles and folds. Class A contains the Merinos with heavy wrinkles and folds. The extreme American type of Merino and the Spanish Merino are the leading members of this class. Class B shows only a few folds about the neck and brisket, and sometimes the thighs. The Rambouillet and improved American Merinos belong to this class. Class C shows a smooth skin, except for a suggestion of wrinkles at the neck. The Delaine Merinos belong to Class C, which also includes some of the Rambouilllets.

The American Merino is now the smallest of the Merino family, which is the smallest type group of all the various breeds. American Merino rams run from 100 to 175 pounds, and ewes from 80 to 100 pounds. The sex terms for sheep are ram, a male sheep for breeding; wether, a castrated male sheep; ewe, female sheep, and lambs, young sheep. The Rambouillet is much larger, having a better mutton form, yet retaining the fine wool. Rambouillet rams average 175 pounds, and ewes run from 140 to 160 pounds. All the Merinos are completely wooled from nose to foot. The head of the American is smaller than the French. Rams of both types usually have spiral horns and the ewes have none. The fleeces are heavy shrinking, very dense and fine, the staple usually running from 2 to 3 inches. American Merino fleeces on account of the folds shear from 12 to 20 pounds, while the Rambouillet yields from 10 to 15 pounds. The Merino fleeces contain so much yolk that they soil badly on the surface. This is known as the "black-topped" effect.



FIG. 10.—American Merino Ewe, Class A.



FIG. 11.—Rambouillet Ram, Class B.

Merino wools are the most valuable wools produced in large quantity in the world. It is estimated that the quantity of fine wools grown, coming under the Merino classification, only represents 25 per cent. of the world's wool production, and the tendency is continuous toward "mutton sheep." Merino wools are noted for their softness, fineness, strength, elasticity, and especially desired for their superior drawing, spinning and felting properties. For spinning the finest woolen and worsted yarns, Merino wools are an absolute necessity. Flannels and knit goods of high quality, suiting and dress goods of fine texture, face-finished fabrics such as broadcloths, billiard cloths, doeskins, meltons, uniform cloths, etc., are dependent on Merino stock, as no other wool would give the required appearance, handle, finish and character which distinguishes each of these fabrics, and in many cases no other wool could be spun to the required yarn sizes.

Australia now supplies the greatest quantity of Merino wool for the market. South Africa and South America follow in the order named. The River Platte district in South America is a great wool growing region, and takes in Northern Argentine and Uruguay. Australia, South America and South Africa manufacture but a fraction of the wool produced, the great bulk being shipped to European markets, the most important of which is London. The United States only grows about one-half of the wool needed for manufactures each year.

### 35. Complete List of Merino Breeds.

SPANISH.	RUSSIAN.
Estantantes .....	B
Chunah .....	C
Escurial .....	B
Transhumantes .....	C
Leonese .....	B
Negretti .....	A
Guadaloupe .....	C
Paulor .....	C
Infantado .....	C
FRENCH.	
Rambouillet .....	A
Delaine .....	A
Dishley-Merino .....	A
Soissonais .....	B
ITALIAN.	
Sardinian .....	B
Sicilian .....	C
GERMAN.	
Saxony .....	A
Hanovarian .....	B
Prussian .....	C
AUSTRIAN.	
Hungarian .....	B
Silesian .....	A
POPULAR BREEDS OF MERINO SHEEP, WELL KNOWN IN THE WOOL TRADE	
Tasmanian.	Spanish (Negretti).
Wanganella.	Vermont.
Bungaree.	Franco-American.
Saxony.	Hungarian.
Silesian.	Italian (Improved Sardinian).
Delaine.	Hanovarian.
French or Rambouillet.	Russian (Improved Dronski).
Dishley (French).	East Indian (Nepal).

A—Popular breeds, improved types, large flocks.  
 B—Old breeds still kept in large flocks.  
 C—Very old breeds, almost extinct.

### KEY.



FIG. 12.—Wanganella Merino Stud Rams, Australia.

**36. Characteristics of Various Merino Wools.**—Saxony, Silesian, Spanish and French Merino wools are all grown in Continental Europe, and the great bulk is manufactured into textiles in the countries where the wool is grown. Very little of this wool ever enters the open market, and none is imported by the United States. These European Merino wools are noted for their fineness, the major portion of them are worked on the woolen system. The length of fiber is usually under 2.5 inches.

Australian Merino wool is especially suited for making worsted yarns on the French or English (Bradford) systems, as it ranges from 2 inches to 5 inches in length. Another valuable feature of Australian Merino wool is the good white obtained by scouring. Cape Merino wool is also noted for its snowy whiteness when scoured, and is very deficient in felting properties. The wools grown in New Zealand and Tasmania are always included under the head of Australian wools unless a distinction is specifically made. South African and South American Merino wools average in length from 2 to 3 inches and from 2 to 4 inches, respectively. The South American imported by this country is usually spun into worsted yarn on the English system. It is considerably weaker than the other Merino wools mentioned, and has a tendency to be harsh and wiry. It is inferior to the

others in drawing, spinning and felting properties, and possesses considerable luster. One of its drawbacks is the fact that the fleeces pick up a tenacious spiral burr, which grows on the ranges, and parts of these burrs often carry through the manufacturing processes, and show up in the yarn and finished fabric. Naturally this is a detriment.

**37. Merino Wools of the United States.**—American Merino wools, with one small class excepted, are divided into two classes, "domestic" and "territory." The domestic Merino wools are those grown in the Eastern and Central States. The principal States growing domestic Merino wools are Ohio, Pennsylvania, West Virginia, New York, Michigan, Vermont and Indiana. The most important section is the Ohio River Valley, and comprises Ohio, southwestern Pennsylvania and the eastern part of West Virginia. These fine wools compare favorably with any in the



FIG. 13.—Tender Wool Showing Break.

world, and are fully equal to the finest Australian. They are unusually sound and strong, and are the most valuable American wools. The domestic wools are as a rule almost entirely free from burrs and dirt. The shrinkage represents the actual grease and suint, and is very uniform. Special attention is given to breeding, the sheep being housed and given every possible attention. In addition to the term "domestic," these wools are also known as "eastern," "fleece," "farm," and "native" wools. The length of these domestic Merino wools varies from 2 to 5 inches. Three inches and over, in Merino wools from the Ohio Valley, are known as "delaine" wools (see glossary), and are obtained by careful selection in breeding. The Delaine Merino sheep are between the American and Rambouillet for size. Rams weigh from 140 to 200 pounds, and ewes from 100 to 150 pounds. The fleece is lighter shrinking than the other two types just mentioned, and the weight runs from 9 to 18 pounds. The length of fiber in Delaine wools makes them especially adapted for worsted yarns. The term "delaine" is often applied to all "domestic" Merino combing wools grown in this country. Territory combing wools are usually known as "staple."

**38. Territory Wools.**—The territory wools, also known as "western" and "range" wools, are those grown in the States of Montana, Wyoming, Idaho, Nevada, Utah, Arizona, New Mexico and Colorado. Most of the wool produced in Washington, Oregon and the Dakotas is classed as territory wool. At one time all wools grown west of the Missouri River were classed as territory wools. The name "territory" was given to these wools because they were grown in the western part of the country which had not been admitted to statehood. The term "ordinary" is sometimes used for "clothing" or "carding" territory wools. It will be noticed that the States named comprise the Rocky Mountain Plateau. The sheep producing territory wools graze over the open ranges and are very hardy. They seldom receive any housing or protection from winter storms and blizzards, and are rarely furnished with fodder. The cold winters cause the sheep



FIG. 14.—Frowsy Wool.

to grow heavy fleeces. In summer, the flocks often suffer through long droughts, causing a scarcity of water, and poor pasturage. At its best, the grass is never so plentiful or rich in this region as in other parts of the country. Tenacious burrs abound in the greater part of the ranges, and become entangled in the fleeces. The burr picking machine is frequently unable to remove these burrs from the grease wool, and this necessitates the use of the carbonizing process later, to remove the burrs.

The soil on most of these western ranges is sandy and alkaline. The nature of the soil, sickness due to insufficient nourishment at various times, and exposure, weaken the wool in the fleeces of these sheep, and at its best, territory wool never equals similar domestic wool. Most of this territory wool runs from 1.5 to 3 inches in length. The fiber is fine, but weak, tender and harsh. The territory wools have a very high shrinkage, due to the large quantity of sand, which adheres to the yolk in the fleece.

**39. Influence of Farming in the West.**—Territory wools are the greatest factor in the wool production of the United States, but the supply is gradually decreasing, due to the encroachment of farms, which are slowly taking over the ranges in this, the last stronghold of the old-time sheep grower. As the ranges come into demand for farming purposes, the land is too valuable to hold for sheep grazing, and with the development of irrigation and intensified cultivation of the soil, the bulk of the wool-growing industry of this section will probably become incidental to farming in the same manner as in the older parts of the country. This is an unfortunate condition, as the United States at present only grows a trifle less than half the quantity of wool consumed in its textile establishments. With the ever-increasing population of the world and the consequent decrease in the world's wool production, the time does not appear relatively far distant when there will be a real scarcity of wool, and unadulterated woolen and worsted clothing will be too expensive for many people in poor circumstances. A satisfactory artificial substitute for wool has yet to make its commercial appearance, although many chemists have endeavored to invent one. It is very unlikely that such an artificial substitute will ever be created.

**40. Various Territory Wools.**—The territory wools from the different producing States vary slightly in their characteristics from one State to another, and an expert wool buyer seldom errs when judging a fleece as to the State in which the wool was grown. However, they grade into one another almost imperceptibly. Differences in these wools, which can be recognized by the eye, are difficult to describe.

*Montana* wools, as a whole, are the best of the territory clips. The shrinkage is light compared with other territory wools. Long staple, comparative softness, good felting qualities, and attractive appearance are the features of Montana wool. In color, they have a slight creamy tinge, which shows up after scouring. This makes them unsuitable for white goods. They are weaker than most of the territory wools.

*Wyoming* wools are next in importance to *Montana* wools. The fleeces vary from gray to reddish gray in color, and the wool has a wild, harsh feel. These features are due to the alkaline soil over which the sheep graze. The shrinkage is heavy, due to the large amount of sand mechanically held in the fleeces. It is the strongest of the territory wools and of fair length. It is noted for its whiteness when scoured.

*Idaho* wools compare favorably with *Montana* wools as to shrinkage. One of the most widely known territory wools is the Triangle or Soda Springs wool. The latter term is given from the fact that the wools are grown in the section surrounding this town. Other important shipping points for wools grown in this section are Pocatello, Idaho; Granger, Wyoming, and Ogden, Utah. These three towns form the three points of a triangle, and the name "Triangle" has been applied on this account to the wools grown in the section indicated. The Triangle wools are noted for less shrinkage and longer staple than the wools grown in surrounding sections. Practically all the wools grown in the western part of Idaho are long and fine. These wools often grade 80 per cent. staple. In the eastern part of the State the wools are generally shorter.

*Montana*, *Wyoming* and *Idaho* wools are the best of the territory wools. They are of about equal value and are usually grouped together in the market quotations for wool in the trade papers.

*Utah* and *Nevada* wools are inferior to those grown in the previous three States. These wools are all rather short, the great bulk being classed as clothing wool. The principal reason for the *Utah* wools being inferior to those of *Montana*, *Wyoming* and *Idaho* is usually attributed to overstocking the range. *Nevada* wool has a very high shrinkage.

*Colorado* wool is greatly inferior as a whole to that grown in the five States previously mentioned. The best wool from this State comes from the northern part, and has a light shrinkage. *Colorado* wools in general are often called "breedless," and the average shrinkage is about 70 per cent.

*Arizona* and *New Mexico* wools are generally poor and uneven. They are similar to Colorado wools, and are usually grouped with them. As a rule, little care is given the flocks, and less care is taken in breeding, and as a consequence, the wool is inferior and usually kempy. This condition is largely due to the ignorance and laziness of the Mexicans, who own most of the flocks. In fact, the wool from American-owned flocks is worth several cents more a pound.

The group excepted in the domestic and territory classification of American Merino wools is "Texas and California."

*Texas* and *California* wools, though grown far apart, are very similar to one another, and are usually grouped together. They are often included among the territory wools, but for several reasons it is better to consider them separately. Most of the sheep run the range, and the bulk of them are sheared twice a year. For this reason the wool is known as Spring and Fall Texas or California. Another method of designating these wools is six months, eight months, and twelve months Texas or California, depending on the time the fleece was allowed to grow. California wools are also divided into northern, middle and southern counties. The northern counties wool is usually grown a year before shearing, and is the most valuable. In the middle and southern counties the wools shrink more, and the sheep are sheared twice a year. The spring wool is usually eight months' growth and the fall wool six months. April and September are the usual shearing months for Spring and Fall wools, respectively. The former is naturally longer and shrinks less than the fall wool. The length varies from  $\frac{1}{2}$  inch to 1.5 inches for six and eight months' wools, and from 2 to 3.5 inches for twelve months' wools. The shrinkage averages 65 per cent. These wools are noted for their softness, fineness, strength, elasticity and excellent felting properties. They are a necessity for high-grade fabrics requiring heavy shrinkage or gigging, or both to obtain the required finish. A few of these high-grade fabrics are the choicest broadcloths, billiard cloths, chinchillas, kerseys, meltons, beavers, uniform

cloths, and bed blankets. The short fibered wools are especially desired where a napped face is desired, as they furnish more fiber ends to cover than longer wools without materially weakening the fabric or breaking the staple.

*Texas* and *California* short-wool fleeces are not tied, but are tightly packed in bags. *California* wools are frequently baled. The mestiza burr is common on the ranges of southern *California*, and these wools must be carbonized to remove the burrs. Such wools are known as "defective," in order to distinguish them from "free" wools. Most of the *Oklahoma* wools are included with *Texas* wools.

*Louisiana* "lake" and some *Georgia* wools are, in a general way, similar to the short wools of *Texas* and *California*, but come under the domestic classification. They are unimportant, as the relative amount produced is very small. These wools are also clipped in the spring and fall, and usually run very kempy. Little attention is given to breeding the sheep, and as a consequence the wool is inferior to that of *Texas* and *California* for fineness and evenness.

**41. British Types of Sheep.**—The British breeds of sheep have always been bred from a mutton viewpoint, the quality and character of the wool being a second consideration. The block standard is the aim of all breeders of mutton sheep. The British breeds are subdivided according to the character of their wool into the long wool and medium wool breeds. The medium wools are divided into two distinct classes—namely, the "down" and "mountain." The down class is far more popular than the mountain, as the latter are much smaller sheep. The block standard requires the sheep to be low-set, deep, wide and symmetrical. These requirements furnish the carcass with the highest percentage of desirable parts for meat, and enable the butcher to cut to the best advantage with little waste. Such types furnish about 50 pounds of dressed carcass per 100 pounds live weight.

**42. Conformation of Mutton Sheep.**—The following excellent description of the characteristics and distinguishing features of the mutton type of sheep is taken from Dr. Carl W. Gay's work, "The Principles and Practice of Judging Live Stock," published by The Macmillan Company:

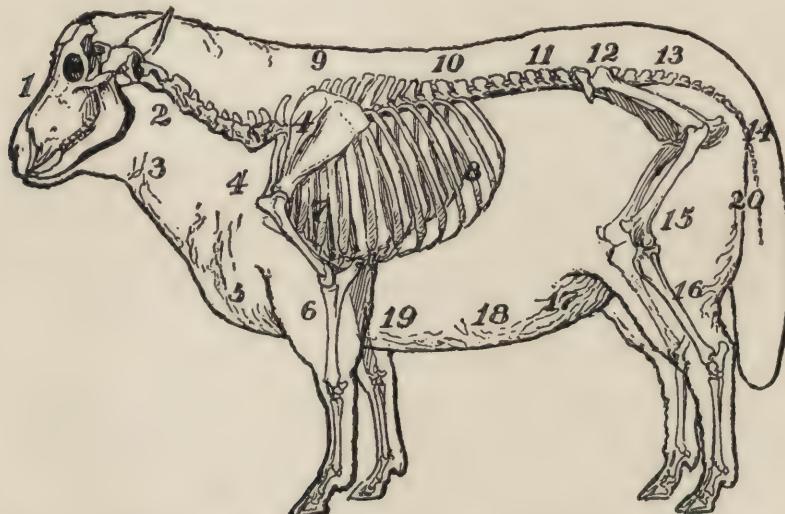


FIG. 15.—Points of Sheep: 1, head; 2, neck; 3, shoulder vein; 4, shoulder; 5, brisket; 6, foreleg; 7, chest; 8, ribs; 9, top of shoulder; 10, back; 11, loin; 12, hip; 13, rump; 14, tail; 15, giggot or leg of mutton; 16, hind leg; 17, flank; 18, belly; 19, foreflank; 20, twist.

"Head short, broad and deep; a large, full, clear eye; broad muzzle, large nostrils; fine, well-shaped ears, nicely poised and carried. The size and shape of the head, also whether covered with wool or hair, and the carriage of the ears is a matter which involves the breed, as does also the presence or absence of horns. The horns of the horned breeds should be strong, or fine, depending upon sex, of good texture and symmetrical in size and shape. The neck desired is short, thick just back of the poll and begins there to swell into the width of the shoulders, being especially full in the neck vein. Typical shoulders are broad, not prominent, but closely laid in, and well covered with flesh, both at the side, where they are apt to be bare, and over the top, where they are often too open; that is, having too much space between the

tips of the shoulder blades and the spine; the back straight, strong, broad and especially thickly covered with flesh; the ribs well arched and deep, especially the forerib; the crops so well filled as to be even with the sides of the shoulders; the chest deep, full, broad on the floor, and square at the brisket; the loin broad, and thickly fleshed, this region being most frequently bare; the hips broad, level, smooth and not too prominent; the rump long, level, broad and smooth, especially at the dock, where there may be an accumulation of blubbery tallow; the leg of mutton broad, deep and thick; the twist full and well let down in the seam; the legs short, straight; pasterns and hocks strong; the sheep standing well up on its toes, and having straight hind legs."

**43. Mutton Qualities Influenced by Breed.**—It must be borne in mind that the quality of the meat is dependent on the quality of the sheep, and in turn the quality is determined principally by the breeding. The breed influences the quality of the meat as much as it affects the character and quality of the fleece. Sheep, yielding a choice meat, show a refined head and ears, smooth shoulders, and hips, clean-boned joints and cannons, fine hair on the face, ears and legs, fine fleece, and a trim under line. The flesh should be firm, but slightly yielding.

The improvement of the fleeces of sheep by selection and breeding has been practiced for centuries, but the development of the mutton breeds was started less than two hundred years ago.

The production of mutton has become very largely a business of furnishing lambs to the market. As in beef and pork, the demands of the market call for young meat and comparatively light weights of carcasses. The premium paid for baby beef and bacon hogs applies with even greater force to sheep. Thick, fleshy, but rather light joints are demanded by the cook, whether for the home table or the restaurant. The tastes of the consumer have been cultivated to discriminate in favor of the tasty, tender lamb, until we find that from 70 to 80 per cent. of the sheep which reach the market are less than one year old. The age of

heavy mutton seems to have passed. This is a condition which is most favorable to the sheep raiser, who is thus enabled to secure quick return from his flock. In the very nature of things there will always be mature sheep sold as mutton, as the breeding stock must sooner or later reach the block. The increasing demand for lamb mutton indicates a good future for the industry, provided care is taken to keep up and improve the grade of the product. Careful attention is needed not only to the production of the rapidly growing lamb, but that it possesses the qualities called for by the high-class trade. A prime lamb is in demand and will always command a high price, while the skinny, bare-backed sheep is not wanted at all. The market wants flesh in any case, and when it comes from the back, the loin, or the leg so much the more it is prized.

The raising of lambs for the market requires, first of all, a strong uniform flock of ewes which are active foragers, uniform and regular breeders, and copious milkers. It is also important to pay some attention to the shearing qualities of any flock of sheep.

**44. Classification of Wool from Mutton Breeds.**—The wools grown by these mutton sheep are known as down (medium) and long, depending on the breed. The long wools include coarse, semi-luster and luster wools. According to the following list, which was prepared by W. T. Ritch, an Australian wool expert (who for several years past, has been engaged in introducing the Australian methods in the West), there are thirty-eight distinct breeds of sheep in Great Britain, all of which belong to the mutton class. It is only natural that the most popular of these breeds should have found favor in British colonies, which have found sheep-growing profitable. Nearly all the sheep of Canada and New Zealand belong to the mutton type, and while the Merino is still dominant in Australia and South Africa, nevertheless the well-known British breeds are continually gaining ground. Merino sheep have been introduced in Great Britain, but they do not

prosper, as the climate is unfavorable, and the heavier breeds are desired for their mutton.

#### 45. Complete Classified List of British Breeds.

##### MOUNTAIN.

Name of Breed	Native District
Highland Blackface—C	Scotland
Herdwick—C	Cumberland
Welsh Mountain—C	Wales
Ronaldshay—D	Orkney Islands
Hebridean—D	St. Kilda
Manx—D	Isle-of-Man

##### HILL.

Cheviot—A	Scotland
Kerry Hill—C	Wales
Gritstone—C	Derbyshire
Shetland—C	Shetland Islands
Radnor—C	Wales

##### DALE.

Wensleydale, Blueface—C	Yorkshire
Wensleydale, Longwool—C-B	Yorkshire
Cotswold—A-B	Gloucestershire
Swaledale, "Marsham"—C	Yorkshire

##### HEATH.

Clun Forest—D	Flint and Salop
Penistone—D	Yorkshire
Limestone—D	Westmoreland
Norfolk Horn—D	Norfolkshire

##### MOORLAND AND UPLAND.

Loink—C	Lancashire
Dartmoor—C	Devonshire
Exmoor Horn—C	Devonshire
Dorset Horn—A	Dorsetshire

##### LOWLAND.

Lincoln—A-B	Lincolnshire
Devon Longwool—C-B	Somerset and Devon
Leicester, "English"—A-B	Leicestershire
Romney—A-B	Kent
Roscommon—C-B	Ireland
Border-Leicester—A-B	South of Scotland
South Devon—C	Cornwall and Devon

## DOWN.

	Name of Breed	Native District
Shropshire—A		Salop
Ryeland—C		Herefordshire
Oxford—A		Oxon
Hampshire—A		Hants
Suffolk—C		Norfolk and Suffolk
Southdown—A		Sussex
Dorset-Down—C		Dorsetshire

## KEY.

A—Popular and important breeds.

B—Longwool breeds suitable for crossing with Merinos.

C—Breeds seldom found outside of Great Britain.

D—Very old breeds, likely to become extinct in a few years.

## 46. British Breeds Classified According to Character of Wool.

(Important Breeds in Large Type)

## LONGWOOLS (Coarse Wool Character)

LINCOLN.	Herdwick.
COTSWOLD.	Wensleydale, Bluefaced.
LEICESTER "ENGLISH."	Wensleydale, Longwool.
LEICESTER "BORDER."	Swaledale.
ROMNEY.	South Devon.
ROSCOMMON.	Dartmoor.
Highland Blackface.	Devon Longwool.

## MEDIUM WOOLS (Mountain Character)

CHEVIOT.	Penistone.
Shetland.	Lonk.
Radnor.	Hebridean.
Ronaldshay.	Manx.
Gritstone.	Limestone.

## MEDIUM WOOLS (Down Character)

SOUTHDOWN.	Ryeland.
HAMPSHIRE.	Exmoor Horn.
OXFORD.	Norfolk Horn.
SHROPSHIRE.	Kerry Hill.
DORSET HORN.	Clun Forest.
Suffolk.	Welsh Mountain.
Dorset-Down.	

This classification furnishes a relative comparison of the length of staple in the fleeces of the various British breeds. In addition to the average length of staple, there is considerable variation

in the character of the wool produced by the different breeds within the same group. In the long-wool breeds there is considerable similarity with the exception of the Herdwick and Scotch Blackface, and these are unimportant. The medium wools of down character as produced by the various down breeds are very similar to one another in character and length. The medium wools of mountain character usually show wide variation in every feature except length, which is about half way between the staple length of the long wools and the medium wools of down character.

All British breeds are named after the county or district in which they originated and in which they are still located. Any stranger traveling through Great Britain by rail can easily tell which county he is passing through by observing the sheep through the car windows as they are grazing. Livestock specialization and intensive farming have proved that the various breeds give the most profitable results in their own localities. In Australia and New Zealand, the various breeds are also located in certain districts for the same reason. In South Africa, South America, and even in Canada, efforts are being made to have each breed located in the most suitable district, and the results so far are very encouraging. In the United States alone, this natural law of the most suitable locality and environment is ignored, as every farmer merely buys the sheep he fancies.

These two lists of British breeds of sheep, one classified according to the original home or territory of the breed, and the other divided into three groups, according to the length and similarity of the wool, have nothing to do with the rules of classing wool, yet they show that the descriptive terms used in the wool trade sometimes differ from those used by breeders. In crossbreds the International wool terms fortunately fit in very well with those used in Animal Husbandry.

**47. Description of Important Long-wool Breeds.**—With a few exceptions, all the important British breeds, which are shown in large type in the preceding list, have found favor in the United

States. These wools are better known in the trade as luster and semi- or demi-luster wools, and do not possess good felting properties. They are distinctively combing wools, and are spun on the Bradford system for lustrous dress goods, linings, braids, etc. These luster wools are not raised on an extensive scale in this country, but a small quantity is produced in nearly every State, with Kentucky and Indiana the most important.

**48. Lincoln.**—This breed is the largest and heaviest of domesticated sheep. It grows about the heaviest fleece of any breed, and averages from 14 to 18 pounds. The Lincoln is a very old breed,



FIG. 16.—Lincoln Shearling Ram.

which originated in Lincolnshire. The original Lincoln was improved by a cross of Leicester blood, which brought refinement to the breed, and improved the quality of the meat, which is of a coarse texture. Lincoln rams vary in weight from 200 to 250 pounds. It grows a very long wool, from 8 up to 15

inches. The wool is noted for its luster, strength, whiteness and soundness. Lincoln sheep can be distinguished by their huge, massive block form. A tuft of wool grows on the forehead. The face, ears and legs below the knees and hocks are covered with white hair. Large numbers of Lincoln sheep are found in Canada, New Zealand and South America.

**49. Leicester.**—This breed was improved by Bakewell, and was the first breed to receive attention. Naturally it was largely used for improving the other British breeds of sheep. Leicester sheep are natives of Leicestershire, Yorkshire, and the South of Scotland. They are very hardy, and thrive especially well in cold, bleak climates. Leicester rams average 225 pounds, and ewes run from 175 to 200 pounds. They have a square outline, with a comparatively high stand. The rump is very prominent and well rounded. They have a broad head, prominent between the eyes, and tapering toward the muzzle with the nose inclined to



FIG. 17.—Border Leicester Shearling Ram.

be Roman. The ears are fine and well poised. Both ears and face are covered with short white hair with an occasional black spot. The expression of the Leicester countenance is very "sheepy," giving a mild, sleepy and timid effect. Leicester sheep have black hoofs and lips. This breed is conceded to possess the best back of any breed of sheep. The wool runs from 5 to 8 inches in length, color a good white, and the wool falls in ringlets. Leicester wool is much finer than that from the Lincoln sheep. The fleeces weigh from 9 to 11 pounds, and are often bare on the under side of the body.

Between the two types of Leicesters there is a slight immaterial distinction. The Border Leicester has a white face, free from wool, a more rugged appearance, and is the more numerous of the two. The English Leicester, also known as Bakewell Leicester, is the other type, and can be distinguished by its bluish face, and the tuft of wool on its head. Leicester sheep are seldom found in the United States; but find favor in England and Canada.



FIG. 18.—Cotswold Ram.



FIG. 19.—Romney Marsh Ram.

**50. Cotswold.**—This breed takes its name from the Cotswold Hills in Gloucestershire, England. Cotswold sheep closely resemble the Lincoln in many ways. The head is carried high, and grows a heavy forelock, which falls over the face and eyes. The ears and face are covered with white or grayish white hair. The weight ranges from 200 pounds to 250. The fleece, evenly distributed all over the body, is divided into locks, and is open and wavy. The weight of the fleeces is from 15 to 18 pounds. From 10 to 15 inches in length is the average range of Cotswold wool. The Cotswold is much more numerous in the United States than the Lincoln and Leicester breeds, but its principal use outside of England is for crossbreeding purposes.

**51. Romney.**—There are two divisions of the Romney breed, Romney Marsh and Romney Upland. The Marsh is the most popular. This breed is native to Kent County, England, and as the city of London is right at hand, it is easy to account for this

breed being sought particularly for its mutton qualities. The conformation and wool closely resemble the Lincoln, although the wool is usually finer. Outside of England, the Romney sheep are popular in New Zealand and Argentina for crossbreeding.

**52. Roscommon.**—This breed is confined to Ireland, and the bulk of the sheep of the Emerald Isle belong to it. The breed is more widely known as "Irish," and is a good mutton sheep, growing a long, strong, coarse, luster wool.

**53. Description of Important Medium Wool Breeds.**—The "down" breeds furnish the bulk of the British medium wools. The most important are the Southdown, Shropshire, Hampshire, Oxford and Dorset Horn. The Southdown is named from a range of low, chalky hills, where grass is always green and luscious, known as the "Southdowns" in Southern England. The others are named from the counties in which the breeds were developed.



FIG. 20.—Southdown Ewe.



FIG. 21.—Southdowns at Pasturage.

These down breeds are noted for their mutton qualities, and there are no great distinctions in type. The wool is much finer than that of the long wool breeds previously described. It is also much softer, with good crimp, strength and elasticity. At one time down wools were only used on the woolen system, but the improved combing machinery has made them all available for worsteds. The down breeds are the most popular in England, and have found favor in all the important wool-growing countries. Down wools grade from  $\frac{1}{4}$  to  $\frac{1}{2}$  blood. The usual length ranges from 3 to 5 inches. In the United States, the Shropshire, Oxford and Hampshire are the favored British breeds.

**54. Southdown.**—This is the smallest of the down breeds, rams averaging 175 pounds and ewes 135 pounds. The Southdown is the oldest, best known and purest breed of this type, the other down breeds being developed from it by improving with such larger breeds as the Leicester, Lincoln and Cotswold. It possesses the most compact, broadest, deepest, lowest down and most thickly fleshed form of any sheep. The head is unusually short, wide between the eyes, and rather fine. The ears are short, small,

pointed, and covered on the outside with little tufts of wool. Below the eyes, the face is without wool, and is covered with brownish, gray hair. The cheeks and forehead are well covered with wool. The legs are covered with brownish gray hair like the face. The Southern fleece is very dense and light shrinking, grading  $\frac{1}{2}$  and  $\frac{3}{8}$  blood. The fleeces weigh from 6 to 8 pounds. The wool is short and evenly distributed.

55. **Shropshire.**—This has only been recognized as a distinct breed since about 1860, but it has come into strong favor. It was evolved by using Southdown rams on native ewes of Shropshire and Staffordshire. The Shropshire is a very popular breed in this country, and thrives well in nearly all sections. It is considerably larger than the Southdown, being intermediate in size, rams weighing 225 pounds and ewes from 150 to 160 pounds. The fleece is evenly distributed, weighing from 8 to 12 pounds. The fleeces are liable to grow black or brown spots of wool, espe-



FIG. 22.—Shropshire Ram.



FIG. 23.—Hampshire Ewe.

cially around the head. The head is carried high and very alert. The general carriage and appearance of the sheep are best described as stylish. An unusual feature found in this breed is the covering of the legs with wool. The head is completely covered with wool, except the tip of the nose, which is covered with heavy dark brown hair. The ears are stubby, yet pointed, and covered with fine tufts of wool.

**56. Hampshire.**—The Hampshire is one of the oldest and largest of the mutton breeds, and is found in large numbers in the United States. Rams weigh 250 pounds and ewes 185 to 195 pounds. This breed is noted for the quick growth of its lambs. Hampshire sheep are characterized by a large head, Roman nose, large ears extending straight out, dark brown or black hair on face and ears, and woolled on the forehead and cheeks. They are big boned, especially in the head and legs. The fleece is one of

the poorest of the down wools, running light, open, uneven and short. The wool grades with Southdown for fineness.

**57. Oxford.**—About 1830 the Oxford breed was established, and it is the result of a Hampshire-Cotswold cross. The Oxford is the extreme mutton type, the back and hind quarters are unusually heavy. It is the heaviest of the down breeds, rams weighing from 250 to 350 pounds and ewes from 180 to 275 pounds. The Oxford resembles the Shropshire to a considerable extent. The head is wooled only to the line between the eyes, and is longer than the Shropshire wool. The face is covered with grayish brown hair. One of the most noticeable differences is the covering of the ears and legs with brown hair instead of wool. The ears are also longer and finer than those of the Shropshire, but are carried in the same alert manner. The fleeces are the heaviest, longest and coarsest of the down breeds, weighing from



FIG. 24.—Oxford Ram.



FIG. 25.—Dorset Horn Ram.

9 to 13 pounds. The Oxford is continually gaining favor in this country.

**58. Dorset Horn.**—This breed has received much prominence in recent years, owing to its adaptability for breeding so-called "hot house" or winter lambs. The breed has proven its ability to readily change its lambing season to suit the desires of the sheep breeder, and for this reason they are in good demand for breeding lambs ready for the market in the late winter from Christmas to spring. They are also very prolific. Naturally it is most profitable to keep these sheep in fair proximity to good-sized cities, both for shipping convenience and opportunity for the owner to keep in close touch with the demands of the market for his lambs. The Dorset Horn is intermediate in size, rams averaging 250 pounds and ewes 160 pounds. As the name signifies, the breed has prominent horns, which are formed in a close spiral curving forward. The head grows a wool foretop, with



FIG. 26.—Dorset Horn Yearling Lambs.



FIG. 27.—Cheviot Ram.

the face and ears covered with fine white hair. The wool is short and light shrinking, grading in fineness about halfway between the Southdown and the Oxford. The fleeces are light, averaging from 6 to 7 pounds. The fleeces also run uneven and are bare on the belly.

**59. Cheviot.**—The Cheviot sheep are natives of the Cheviot Hills of southern Scotland. They are of medium size, rams average 200 pounds and ewes 150 pounds. They furnish high-grade mutton. The wool grown has a harsh, wiry feel, which gives the distinguishing character to the best grades of Scotch and English "cheviot" suitings and overcoatings. The fleece is lighter and more open than the average fleeces of the down breeds, yielding about 5 pounds of washed wool. The Cheviot fleece runs even, the wool is pure white, averaging about 8 inches, thus exceeding the down wools in length. Owing to their light fleeces and medium weight, Cheviot sheep have never been extensively raised outside of Scotland. The distinguishing features are a

broad head between the eyes. The eyes are very bright and alert. The ears are carried erect, and the head, ears and legs are covered with fine white hair. The fleece ends abruptly with a "ruff" just back of the ears and about the throat.

**60. Crossbreds.**—This class of sheep is becoming a greater factor every year in the world's wool production. A crossbred, in the general meaning, is the offspring which results from mating a ram and ewe of two distinct breeds. The term "crossbred" is specifically applied to sheep in South America, South Africa, New Zealand and Australia, which have been produced by breeding Merino sheep with one of the mutton breeds of sheep, either of the long-wool or medium-wool breeds. In most cases, the long-wool breeds are used, as the resulting crossbreds are much heavier than those bred from the down breeds. The most popular long-wool breeds for crossbreeding are the Lincoln, Cotswold, Romney Marsh and Leicester. The usual method is to breed long-wool rams with Merino ewes.

Crossbred wools are divided into coarse, medium and fine wools. Coarse crossbreds are below  $\frac{1}{4}$  blood and range from 12 inches down in length. They are lustrous, harsh, possess indifferent felting properties and are fairly strong. Medium crossbred wools include those grading  $\frac{1}{4}$  and  $\frac{3}{8}$  blood. The length is 10 inches and downward. These wools are very strong, lustrous, soft and possess fair felting properties. Fine crossbreds include those of  $\frac{1}{2}$  and  $\frac{3}{4}$  blood qualities. The length is 6 inches and downward. They are very strong, with fair luster, good color, soft handle and good felting properties.

Pure bred mutton rams to be used for crossing with Merino range ewes in this country are mostly secured from breeders in the Northern Central States, the Province of Ontario, Canada, and certain districts in the Pacific Coast States. Some of the valleys in the Coast States are favored with a climate similar to England. In these districts old-country methods are possible. The most important of these districts is the Willamette Valley in Oregon. It contains about 5,000,000 acres, mostly devoted

to raising Cotswold, Lincoln and Leicester rams for the range. Some of the down breeds are also found here for the same trade.

**61. Purpose of Crossbreeding.**—The object of crossbreeding is to obtain a dual-purpose sheep, one which possesses the strong points of each breed to a considerable extent. The Merino is used to give a comparatively fine fleece, and one of the British breeds to improve the weight and form of the sheep and the quality of the mutton. The result gives the sheep owner a high return for both his mutton and wool. The practice has been carried out systematically in New Zealand, South America, Australia and South Africa. Great care and judgment must be exercised in selecting the best adapted breed, and types from the selected breed, to cross with the ewes. The breeder aims to constantly improve his flocks by selecting rams possessing features which will improve any present deficiencies in his flock. A knowledge of the original conditions in the home of the breed rams, such as climate, pasturage, profligacy and disposition, is of great value in determining their usefulness for crossing. The conditions, in the country where the crossbreds are to be raised, should be as near to the home conditions of the breeding ram as possible. The climate, pasturage, soil, etc., vary considerably in different parts of the same country, and what might be the best breed for one section could be a failure in another section. Before breeding season, the ewes should be divided according to the grade of their fleeces, and the rams should be classified in the same manner. By proper selection, the breeder is then able to mate his sheep to produce a fairly uniform crop of lambs, all of the same general form and size, and the fleeces will all grade together.

Unfortunately, there has been little systematic crossbreeding in this country, but recently interest has been aroused. In the past, crossbreeding was conducted in a very haphazard manner in the West, no record being kept of the results obtained, and little attention given to selection. The most popular British breeds used for crossbreeding in the United States are the Cotswold, Hampshire, Oxford, Shropshire and Lincoln. Australia

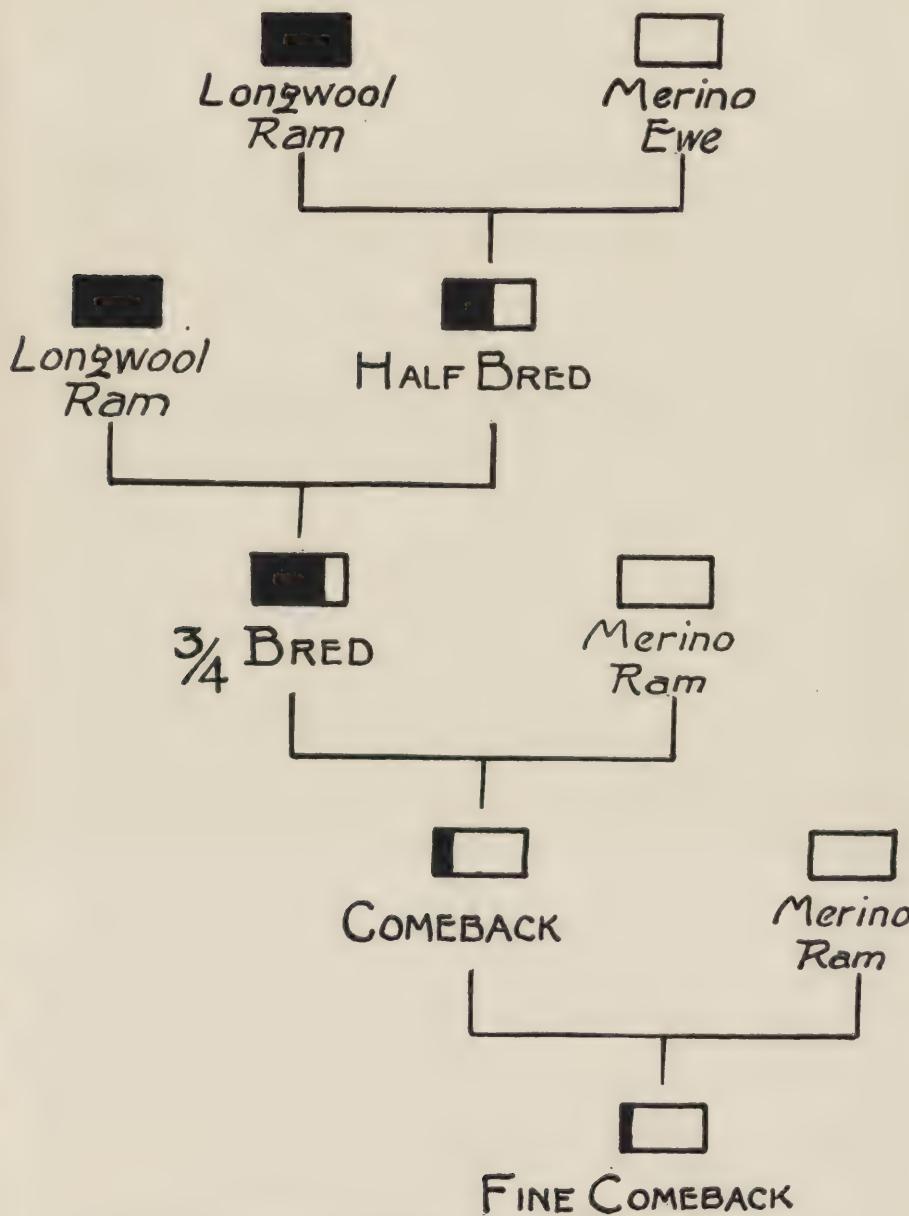
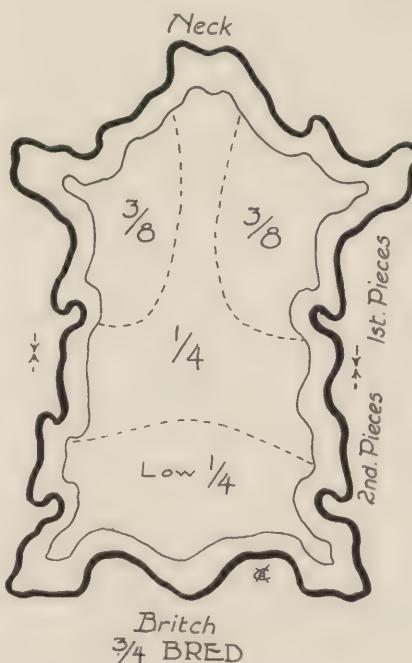
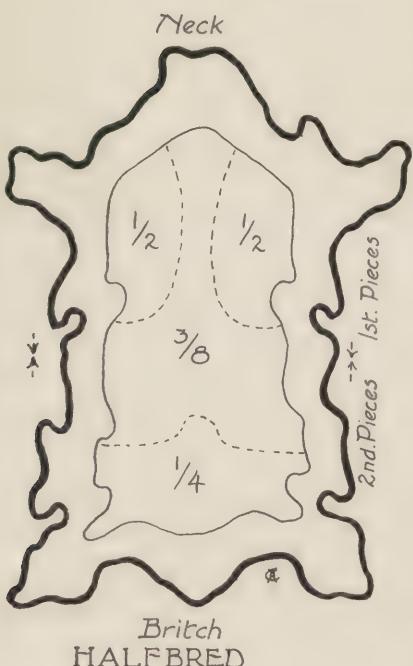
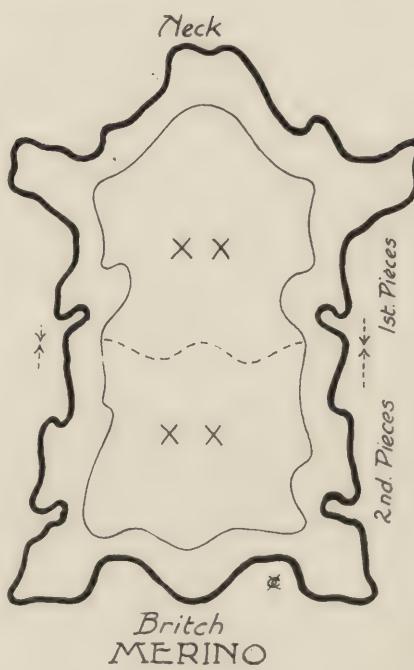
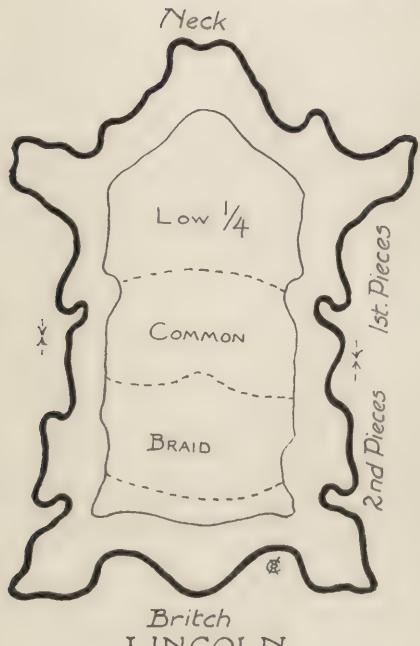


FIG. 28.—Graphic Chart Illustrating Systematic Crossbreeding.

and South Africa are the only important wool-growing countries where the Merinos outnumber the mutton types. About 15 per cent. of the wool grown in Australia is crossbred, and the remainder is Merino wool.

**62. Results of Crossbreeding.**—The following description shows the possibilities and results of scientific crossbreeding, and is illustrated in the drawings of fleeces showing the grades of wool produced by each cross. Consider the crossing of a pure-bred Merino ewe and a pure-bred Lincoln ram, bearing in mind the distinguishing features of each, such as size, form, and the grade and character of the fleece. The result of the cross is a "half-bred." The halfbred ewe is crossed with a pure-bred Lincoln ram, resulting in a "three-quarter bred," which would possess three-fourths Lincoln or long wool, mutton-type blood, and one-fourth Merino or fine wool blood. The terms used do not signify the grade of the wool produced. Breeding any farther than this point toward the coarse wool is seldom practiced. The next breeding step is to breed the three-quarter-bred ewe with a pure-bred Merino ram. The offspring is known as the "comeback," as it loses a considerable part of the Lincoln features and approaches the Merino. The wool produced by this cross is often known in the trade as "comeback." The final cross is produced by mating the "comeback" ewe with a pure-bred Merino ram, and the offspring is called "fine comeback." The halfbred and comeback are very similar; the latter favors the Merino a trifle more than the halfbred and has a slightly finer fleece.

The natural supposition would be that the cycle would repeat itself by crossing the fine comeback with a Lincoln ram; but unfortunately this cross brings poor results, the offspring being irregular and of a nondescript character. Large numbers of these irregular crossbreds are raised in the West with poor returns to the sheep grower, as the fleeces are light, uneven and often weak. The proper method is to cross the halfbreds and comebacks with Corriedale rams, which will hold them as halfbreds year after year with care and proper selection. The other alter-



(Continued on next page)

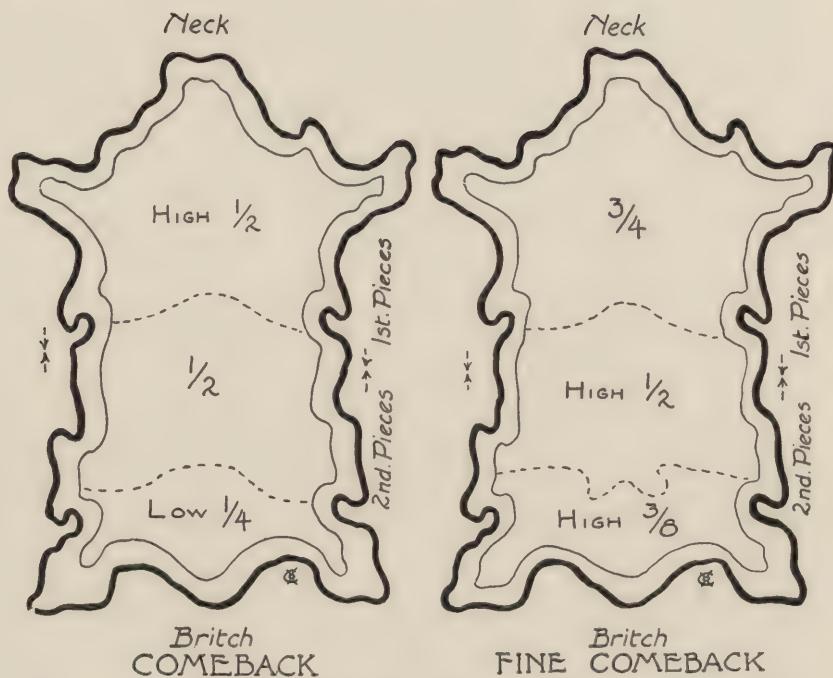


FIG. 29.—Diagrams Illustrating Fleeces Produced by Crossbreeding.

native is to send all the fine comebacks to the butcher and start over again. Romney and Leicester rams on Merino ewes will produce finer wool on the resulting crossbred sheep than the coarser long-wool breeds, such as Lincoln and Cotswold. Crossbred sheep, developed from Merinos and any of the down breeds, naturally produce finer wool than the long-wool crosses, but the down breeds are not used for crossbreeding to the same extent as the long-wool breeds. The contrast between the Merino and down breeds is not so marked as that between the Merino and long-wool breeds. The resulting crossbred sheep from the latter cross are much heavier than those produced by the Merino-down breed cross, and furthermore the wool produced by the crossbred sheep of the long-wool-Merino type is much longer in staple. All the crossbred wools are suitable for worsted manufacture.

An excellent example showing the difference in staple length on medium-wool Merino and long-wool Merino crossbred sheep re-

sulted from breeding experiments by the Agricultural Experiment Station of the University of Wyoming at Laramie. The wool was passed upon by Prof. J. A. Hill, Station Wool Specialist. Two lots of Merino-range ewes were mated respectively with Southdown and Cotswold rams of good type and breeding. The resulting lambs were dropped in the latter part of March and shorn on the second of the following January, the fleeces representing a little over nine months' growth. The fleeces from the Southdown grades, graded as  $\frac{1}{2}$  blood, averaged 2.75 inches in staple growth, and the average shrinkage was estimated at 51 per cent. Sixty per cent. of the fleeces from the Cotswold grades were graded as  $\frac{3}{8}$  blood and the remainder as  $\frac{1}{4}$  blood. The average staple length was 4.1 inches and the average shrinkage was estimated at 43 per cent.

**63. Carpet Wools.**—As the name indicates, these wools are principally used in the manufacture of carpets and rugs. They



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FIG. 30.—Native Sheep of Egypt.

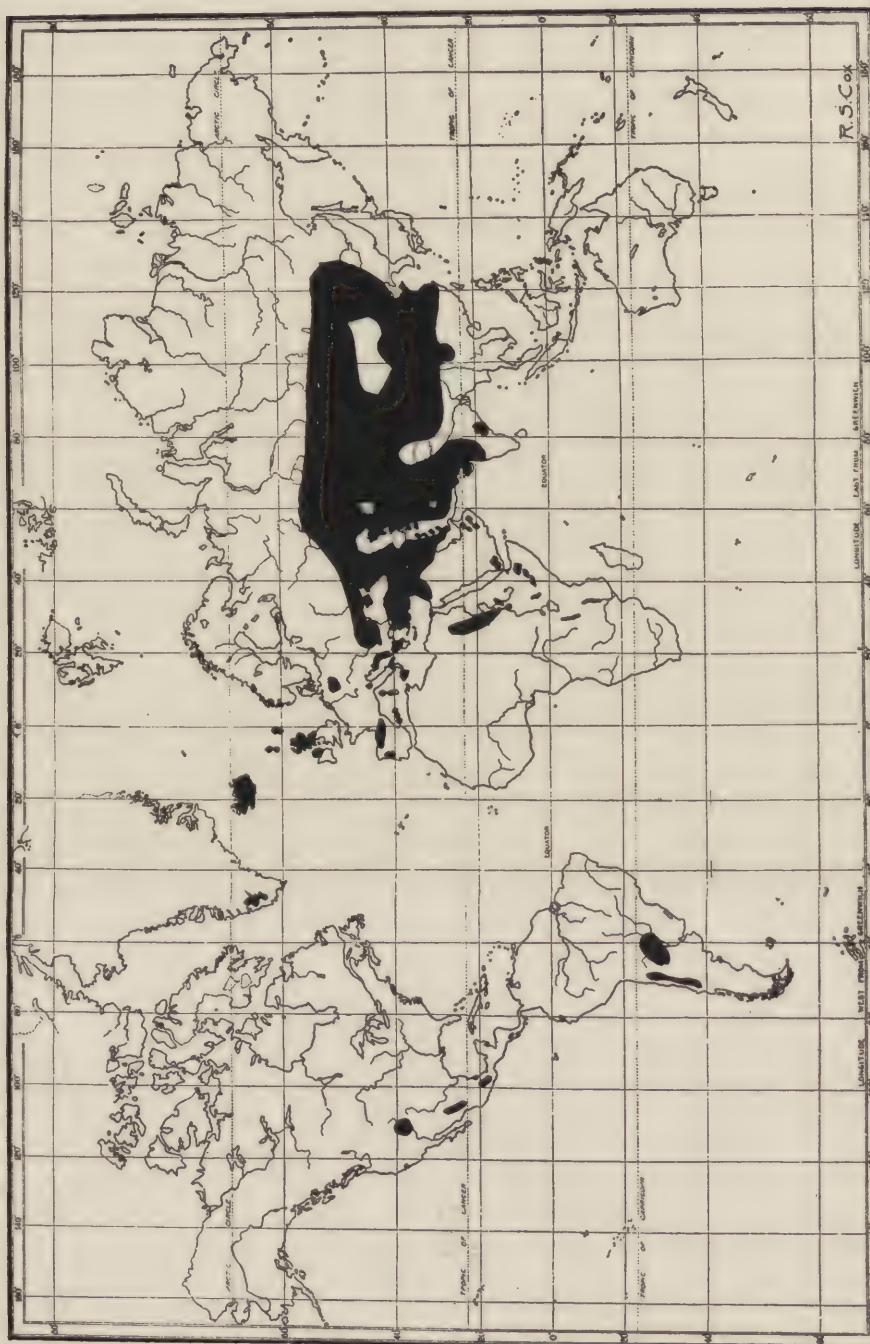


FIG. 31.—Map of World Showing Source of Carpet Wools.

are mostly produced in Asia and Southeastern Europe by unimproved native sheep, most of which are the fat-tailed sheep which are valued more for the oil and fat obtained from the carcass than the wool grown. Most of these sheep are sheared twice a year. Large quantities of carpet wools are "pulled" or "skin" wools, obtained from the pelts of slaughtered sheep. The great bulk of these wools is produced in Asia, Russia and Asia Minor, although practically all parts of the world contribute a limited amount. The fleeces are very light, uneven, coarse and kempy. These carpet wools are inferior to those previously described in the other three classes. Most of the carpet wools are only suitable for wool-spun yarns for use in low-grade Axminsters and Smyrna rugs, art squares and ingrain. Some of the better varieties are of good length and quality, and make good combing wools for Wilton, Brussels and Tapestry carpets and rugs.

At times when wools of the other classes are high in price, cloth manufacturers turn to the better of the carpet wools for relief, but these wools do not give the same results as those they replace. Some of the better grades of carpet wools are mixed with other wools in the manufacture of coarse fabrics, such as the cheaper grades of cloakings, overcoatings, coarse tweeds and cheviots. Some grades are also used for felt boots, horse blankets, coarse upholstery goods, robes, paper makers' felts and wadding for gun cartridges. A large source of supply for carpet wools other than those produced by unimproved native sheep, are the skirtings, britch, badly cotted fleeces, tags and pieces from braid and coarse domestic and crossbred wools. Carpet wools are comparatively coarse, and are usually graded as coarse, common, medium and good. The following table contains most of the important varieties of carpet wools, together with the country of production, and character and usual grade of the wool. Many of the wools included in this table come on the market as pulled, skin or tanners' wool.

## 64. List of Important Carpet Wools.

Variety of Wool	Producing Country	Character	Grade
Scotch black-faced			
or highland wool.	Great Britain	Long staple, strong combing	Common to med.
Oporto	Portugal	Good staple, luster combing	Medium
Sardinian	Italy	Long staple, straight fibered	Coarse
Iceland	Iceland	Straight fibered combing	Medium
Turkish	European Turkey and Balkans	Long, strong combing	Coarse
Donskoi	Russia	Long, straight fibered combing	Medium
Crimean	Russia	Long, straight fibered combing	Medium
Bessarabian	Russia	Long, strong combing	Coarse
Georgian Toucha	Russia-in-Asia	Short to medium staple	Good
Georgian Nouka	Russia-in-Asia	Short to medium staple	Medium
Turkestan	Russia-in-Asia	Short to medium staple	Medium
Bokhara	Russia-in-Asia	Mostly colored medium staple	Medium
Camel Hair	Russia-in-Asia	Varies	Varies
Afghan	Afghanistan	Medium to long staple combing	Medium
Mongolian	Mongolia	Very kempy, medium staple	Common
Angora	Asia Minor	Good sound staple	Good
Smyrna	Asia Minor	Good sound staple	Good
Aleppo	Syria	Good sound staple comb- ing	Good
Bagdad	Mesopotamia	Mostly brown and black, good sound staple	Good
Awassi	Mesopotamia	Good sound staple comb- ing	Good
Karadi	Mesopotamia	Good sound staple comb- ing	Good
Kandahar	India	Both short and long staple	Medium
Joria	India	Short staple	Varies
Marwar	India	Short hairy staple	Coarse
Thibet	India	Medium to long staple combing	Medium
Woosie	China	Short staple	Common to med.
Kinchow, etc.	China	Very kempy, short to medium staple	Coarse to med.
Egyptian	Egypt	Long, lustrous combing	Medium
Soudan	Egypt	Short staple	Common
Valparaiso	W.Coast, S. Amer.	Long, sound staple	Good
Cordova	Argentina	Long, sound staple	Good
Mexican	Mexico	Mostly short staple	Coarse to med.

**65. Miscellaneous Breeds.**—The Corriedale, Iceland and Tunis sheep have not been included among the British types, as they had their origin outside of Great Britain. They are long-wool sheep and good mutton types. Peculiar and special breeds of sheep, which do not come under the classification of the breeds of sheep as described in this chapter, are also considered a part of the miscellaneous group.

**66. Corriedale.**—Authorities disagree as to the breeder originating this breed, which has been established during the past twenty-five years. The difference of opinion is probably due to several breeders working along the same lines and reaching identical results about the same time. One fact is certain, that the home of this breed is the Province of Canterbury, South Island, New Zealand. The type was evolved by crossing the Merino with coarse-wooled Lincoln and Leicester sheep, and then breeding in again by recrossing their progeny until the desired ideal was



FIG. 32.—Corriedale Sheep.

obtained. The Corriedale is an excellent dual-purpose sheep, both its wool and mutton commanding top prices. Selected breeding stock has been sent from New Zealand to Australia, Patagonia and the United States. The Corriedale has retained the block or mutton form of the Lincoln or Leicester from which it was bred, and also grows a very fine wool for such a type, noted for length and sharp regular crimp. The breed retains the herding and grazing properties of the Merino, and possesses a very vigorous constitution. It is especially efficient in hilly districts and snow ranges. The average weight of Corriedale fleeces is 20 pounds for rams, 14 pounds for wethers, and 12 pounds for ewes.

**67. Iceland.**—The sheep of Iceland are the old Norse breed, and there has been practically no mixture with other breeds, as the government has forbidden the importation of sheep for fear of the introduction of disease among the flocks. Little attention is given to the breeding and care of the sheep and wool. The sheep are of medium size, possess a fair mutton carcass, and usually show prominent horns curved downward in both sexes. The fleece is similar to Lincoln wool for quality, but shows a far superior luster, which is its distinguishing characteristic.

Iceland sheep produce an unusually heavy undergrowth of wool in the fleece, and on this account are known as "double-decked" sheep. A peculiar feature of Iceland wool is that the noil is more valuable than the top. When buyers are inspecting this wool more serious thought is given to the percentage of noil which it will yield than the yield after scouring. It is unusually soft and lustrous, and is very desirable for certain knitted and woven fabrics where a high luster is necessary. Unfortunately the supply is very limited, as the flocks of Iceland only number about 900,000 head. Practically all of the wool is shipped to Copenhagen and Liverpool in July and August, and only a small amount finds its way to this country.

In winter the flocks are kept in stables and fed with hay. By the end of April they are turned into the field to graze. The

lambing season begins about the middle of May, and the weaning season begins at the middle of June. Before weaning, the ears of the lambs are branded to indicate the owner. Each farm has its own earmark, which is officially registered. After the weaning season the mother sheep are kept in a movable sheep pen near the farmhouse, and milked every morning and evening. The lambs and dry sheep are driven into the mountains to graze without the care of a shepherd. In September, men are sent out to round up the sheep and drive them down to the farms.

The farmers in the northern part of the island have given more attention to the care of their sheep and the preparation of the wool for the market. These farmers shear the wool from the sheep, but in the southern and western parts of Iceland the wool is usually pulled from the sheep. The wool is sheared or pulled from the sheep in May and June, and then washed by the farmer in his home.



FIG. 33.—Tunis Ram.



FIG. 34.—Winter Lambs with Ewes.

**68. Tunis.**—This breed is a native of Tunis, in Northern Africa, and was first brought to this country in 1800. It has never become important, but recently has received considerable attention from breeders on account of its mutton qualities and its ability to produce winter lambs. The Tunis is of excellent mutton form, is intermediate in size, with the head and legs covered with reddish-brown hair. The breed is without horns. Tunis sheep grow a very long and coarse fleece resembling Cheviot wool in character. The fleeces weigh from 6 to 12 pounds.

**69. Karakul\*.**—The Karakul sheep are natives of Bokhara, a principality under Russian protection in Central Asia. Bokhara is bordered by Turkestan on the north and Afghanistan on the south. A few Karakul sheep are kept in the territory adjoining Bokhara, and some Karakuls are found in Persia, but the stock

\* From United States Government pamphlet "Karakul Sheep," by F. R. Marshall, L. L. Heller and V. O. McWhorter, Animal Husbandry Division, Bureau of Animal Industry.

common to that country and known in the United States as Persians are not valuable as fur producers. The number of sheep in this territory is estimated at from 3,000,000 to 4,000,000. The value of these sheep lies in the fur obtained from the lambs. The common practice is to kill the lambs when but a few days old, as the character of the curls deteriorates with greater age. The skins of prematurely born lambs have value as furs, but ewes are not sacrificed to secure them. The furs obtained from the young Karakul lambs are known as Persian lamb, Astrakhan and Broadtail. These skins are all black in color, but vary in the character of curl. Persians have the most pronounced, most uniform, and tightest curls and the greatest value. Astrakhans have longer hair, the curl is much more open, and usually has less luster or gloss than the Persian lamb. Broadtail skins are taken from lambs prematurely born. Their hair is shorter than on Persian skins, and instead of being tightly curled it is swirled and exhibits a very attractive wavy pattern. In each of these classes of lambskins there are varying grades. The annual exportation of lambskins from Bokhara averages about 1,500,000. The skins are collected by dealers and traders, most of them to be resold at the annual summer fair at Nijni Novgorod, in Russia, 272 miles by rail east of Moscow. About 166 skins are packed into a bale and ordinarily not assorted for export to various countries until after becoming the property of the dealers, largely Germans from Leipzig, who purchase them at Nijni Novgorod. In Leipzig the skins are sorted into uniform lots for export to various parts and a few are also dyed, though as a rule the dyeing is not done until the skins reach the firm by which they are to be made up for wearing apparel.

The Karakul is a sheep of medium size, with black face and legs, and a long, coarse fleece of some shade of gray ranging in length from 6 to 10 inches. It is classed as carpet wool. The conformation of the Karakul does not commend it as a mutton producer. The breed is described as "broad-tailed." It has the narrow back and flat sides common to sheep not bred for meat



FIG. 35.—Karakul Ewe and Lamb.

production. A depression back of the shoulders and a high loin are usually present. The face is narrow and decidedly Roman-nosed. The ears are small, pendulous, and set somewhat low.

Karakul sheep were first introduced in the United States in 1909. The production of these furs in this country appears to be feasible and to present commercial possibilities. The importations have consisted chiefly of rams, which have been mated with ewes of other breeds to determine what class of the readily available ewes are most valuable for mating with Karakul rams to produce lambs having good skins. Flocks owned in Texas, Kansas and New York now comprise over 1000 head of sheep having one-half or three-quarter Karakul blood. Besides these grades, there are 60 rams and ewes that are either imported or descended from imported stock. The imported rams have been largely used upon long-wool ewes, with Cotswold and Lincoln ewes having the preference.



FIG. 36.—Australian Merino Ram, Showing Method of Examining Fleece on Sheep's Back.

## CHAPTER III

### SHEARING, PREPARING AND MARKETING WOOL

**70. Method of Shearing.**—The great bulk of our sheep are now sheared by power clippers, although hand clippers are still used in the East and Middle West where the flocks are small. The invention of the machine shear only dates back about twenty-five years, but only about one-fourth of the world's sheep are now sheared by hand. Sheep shearing requires considerable skill, and experienced shearers average between 175 and 200 head per day, as against 100 head as a high figure for expert hand shearers on our Western ranges. The individual Australian shearing record for one day of eight hours is 316 head. The machine shears clip the wool evenly, leaving a uniform stubble of about a quarter of an inch on the sheep's back, whereas with the hand shearing the stubble is often uneven. The yield of wool per head is naturally increased by the close shearing, and the increased weight gained in this manner is estimated at about 5 per cent. The fleece is also in better condition after machine shearing, as there is less danger of cutting the fibers and tearing the fleece apart. The machine shears frequently leave a slight scratch or two on the sheep's skin, and occasionally through carelessness the shearer cuts under small pieces of flesh, and these adhere to the wool growing from them and often carry through to the card. Owing to their numerous folds, American Merino sheep cannot be sheared advantageously with machine shears.

The cost of shearing in this country averages 10 cents per head. This figure includes rolling and tying the fleeces and packing them in bags, but does not include the cost of the bags. The Australian cost is about 8 cents per head, and this price includes the cost of skirting and classing, which amounts to about 1 cent per head.



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FIG. 37.—Shearing Sheep with Hand Clippers near Auckland, New Zealand.

**71. Shearing Season.**—The spring of the year is the season for shearing. Some sections of the country, where the climate is favorable, such as California, New Mexico, Arizona, and Texas, start shearing in late March or early April. The bulk of the shearing in this country is performed in May and June. Some wools are clipped semi-annually in the spring and fall; the most important of these wools are Texas and California.

In the southern hemisphere the seasons are reversed; the spring season comes at the same time as our fall season. The shearing



FIG. 38.—Machine Shearing in Wyoming.

months for Australia, New Zealand, South Africa and South America are October and November.

**72. Weight of Fleeces.**—Fleeces vary in weight according to the breed and sex of the sheep. In the previous descriptions of the various breeds the average fleece weights of each breed are given. Male sheep, rams and wethers (castrated male sheep) are larger and heavier than ewes and lambs, and naturally yield heavier fleeces. The combined average weight of Australian Merino fleeces is about 8 pounds. Australian Merino rams aver-

age 17 pounds; wethers, 13 pounds; ewes, 10 pounds, and lambs, 2½ pounds. Specially selected stud rams have yielded fleeces weighing 30 pounds.

**73. Method of Machine Shearing.**—Shearing plants have been installed at various convenient locations on the sheep ranges. The buildings consist of long sheds, with shafting driven by a gasoline engine, extending the full length of the shed on both sides of the shearing space. Shearing machines are placed at convenient intervals and receive their power from the shafts. One shearer operates each shearing machine. The sheep are driven to the shearing sheds from the range in large flocks of 2000 or more, and are placed in large corrals next to the shearing sheds. Suitably fenced inclines lead from the corrals to each shearer's stand. When the shearer is ready to start a number of sheep are driven into each chute. The shearer reaches into the chute and pulls out a sheep. The sheep is forced into a sitting position between the shearer's knees by skillful manipulation on the part of the shearer. The shearer now proceeds to shear the fleece, guiding the clipper with the right hand. When the entire fleece is removed the sheep is driven into another chute, which leads into the count-



FIG. 39.—New Shearing Sheds and Range, Bitter Creek, Wyoming.

ing pen. On the way to the counting pen the sheep are branded. As the wool grows it carries the brand mark with it so that it is always easy to distinguish. Helpers fold the fleeces with the dirty side of the fleece inside, and tie them tightly as fast as the shearers throw them on the floor. Each fleece is folded and tied separately, and then placed in a long burlap bag. These bags are hung from a suitable framework, and a man tramps the fleeces down as closely as possible as they are thrown in. From 300 to 400 pounds of wool are placed in each sack.

**74. Australian Method.**—In Australia, each ranch possesses its own shearing plant, or a small number of ranches combine and establish a co-operative shearing shed conveniently located. One important feature practiced in Australia and usually omitted in this country is sweating the sheep prior to shearing. The sheep are transferred from the gathering pens to the sweating pens, which in turn are next to the catching pens from which the shearer takes the sheep. The temperature of the sweating pens is usually 10 degrees or more greater than the normal temperature. The sheep are closely herded together in the sweating pen for two hours during the day or eight hours during the night. Sweating causes the yolk to flow more freely, thereby putting the wool in the best possible condition for shearing. The sheep shear much easier when sweated. The actual shearing is performed in the same general manner as the shearing in this country, except that the shearers handle the sheep more skillfully and gently, and the belly wool is usually shorn separate from the rest of the fleece. Great care is taken to protect the fleece from contact with foreign substances. After the fleece has been removed from the sheep the Australian method of preparing it for the market is widely different from ours.

The fleece, usually  $9\frac{1}{2} \times 4\frac{1}{2}$  feet, is taken to the skirting table and is skilfully thrown on it in such a way as to spread out evenly over it. The skirting table is usually about  $10 \times 15$  feet in size and the top of it is a grid composed of wooden

slats placed five-eighths of an inch apart. Two skirters usually work together at each table; one skirter operates on the fore parts of the fleece and the other man skirts the hind parts. Skirt-



FIG. 40.—Sheep Entering the Sweating Pens, Bitter Creek, Wyoming.

ing separates from the main portion of the fleece inferior and heavy shrinking parts, such as tags, leg pieces, neck pieces, bellies, locks and stained parts. The various skirtings just enumerated are separated by the skirters as follows: The small fragments of wool skirted from the forequarters of the fleece are much finer and lighter shrinking than the inferior pluckings of the britch end. They are known respectively as First Pieces and Second Pieces.

The first and second pieces are carefully gone over, together with the bellies and sweepings from the shearing floor, at the piece picker's table. The tags, stained parts and locks are assigned to individual bins. The piece picker's table is .8 x 3½ feet, and sloped like a desk. The top is made from pyramid slats one-half inch apart to allow dust, sand and twice-cut wool to fall through.

After skirting, the fleece is rolled with the cut side out, and secured by twisting in one end. The proper method of rolling



FIG. 41.—Model "Australian" Shearing Plant, Walcott, Wyoming.

the fleece is to have the flesh side of the fleece down on the table, then turn in a little of the britch end and a little of the neck portion of the fleece. The side of the fleece furthest away is then drawn toward the roller, making two folds. The fleece is now ready to be rolled up from britch to neck. This method places the best portions of the fleece on the outside. The fleeces are seldom tied. When string is used for tying the fleeces a light glazed twine is selected similar to a stout fishing line. The grade is next determined by the wool classer as 44s, 56s combing, or whatever grade it may be, and the fleece is ready to be placed in the bale assigned for that grade. Great care is taken in packing, and the bales are reduced in size by the use of hydraulic presses. The bales usually contain about 40 fleeces and average 330 pounds in weight. Usually heavy jute bagging is used in baling, and is either singed on the inside or lined with paper to prevent loose jute fibers becoming mixed with the wool. Frequently tar-lined paper is used for lining as a preventive against insects and dampness. Each bale is plainly marked with the grower's name or brand and the grade of the wool contained. By this method the grower's identity is maintained until the wool is unpacked at the mill.

The Australian method of handling wools is closely followed in New Zealand and South Africa. In South America, the wool growers are fast adopting the Australian method, and the better wools are usually skirted and baled without tying the fleeces.

**75. Introduction of Australian Method in West.**—In 1915, an "Australian" shearing shed was erected at Bitter Creek, Wyo., and the wool from 80,000 sheep shorn in three weeks was skirted, classed and prepared according to the Australian system. The wool was sold direct to several large mills in the East at prices which more than repaid the sheep owner for the additional trouble. The success of this experiment has attracted widespread attention, and several other similar plants were erected in Wyoming. About 270,000 sheep were shorn in these sheds in 1916, yielding over 2,000,000 pounds of wool. Numerous



FIG. 42.—Shed, Stalls and Pens Leading into Shearing Room, Walcott, Wyoming.



FIG. 43.—Baling Room, Showing Skirting Tables and Shearing Board, Walcott, Wyoming.

additional sheds adapted for the Australian method were erected in Wyoming for the 1917 season. It is expected that the improved method will soon spread through the other Intermountain States. Should this method be adopted too rapidly its success is liable to receive a temporary setback, due to the lack of sufficient skilled wool classers, skirters and piece pickers. Quite a number of green hands, recruited from the student body of several agricultural colleges in Wyoming, have been developed into first-class skirters and piece pickers in these new sheds, and this co-operation on the part of the agricultural colleges will probably prove an important factor in the future development of the movement. The introduction of the Australian method in the West is being supervised by W. T. Ritch, an Australian wool expert, whose services were secured by several large sheep owners of Wyoming.

**76. Poor Preparation of United States Wools.**—A frequent source of trouble to the manufacturer arises from the sisal and other rough vegetable fibered strings used in tying the fleeces. When any of the fibers become mixed with the wool they are carried through to the finished cloth, and as they will not take the dyes used on wool they show up conspicuously. Burling is necessary to remove them, adding an unexpected expense to the cost of the cloth. The use of paper string in tying the fleeces avoids trouble of this kind.

Tags and damp stained pieces are usually folded in the fleece, and will discolor the parts of the fleece in contact with them. When black wool is packed with white, locks from the black fleeces often become mixed with the white and are often missed during sorting. Where the wool is to be used for manufacturing white or light-colored fabrics the presence of black fibers causes great trouble and considerable loss. Fraud is sometimes practiced by unscrupulous growers placing balls of hard manure, stones and other heavy materials inside the tied fleeces to increase the weight. Several years ago an Ohio fleece was found to be tied with 121 feet of stout, rough jute twine.



FIG. 44.—Defective Cloth, Due to Presence of Sisal.



FIG. 45.—American Wool Packed in Old Sacks and Poorly Sewed.

A good marking compound soluble in scouring is badly needed. The use of paint in marking is preferred to tar. The paint has to be clipped by the sorter from the locks, and the small amount of wool imbedded in the paint is of no use to the textile manufacturer.

**77. Wool Marketing in United States.**—Our wool growers avail themselves of numerous ways of disposing of their wool. The factors influencing the selection of a selling method are the quantity of wool offered for sale, distance from large wool market, opportunity for co-operation among neighboring wool growers, knowledge of grades and quality of wool, general market conditions, and the ability of the wool grower to make a shrewd deal.

All things being equal, a large quantity of wool will bring higher proportionate return than small lots. The general price level of wool like every other universal commodity is governed primarily by the two great factors, "supply and demand." The wool grower depends on reports in the newspapers, trade and agricultural papers for information as to the value of his clip. These market reports are based on such facts as can be gathered from buyers and sellers in the main wool-selling centers—Boston, Philadelphia, Chicago, New York and St. Louis. In many cases the grower does not really know the quality of wool his sheep have yielded and is unable to understand the true meaning of the various grades quoted in the market reports. Where a number of buyers are competing for a lot of wool, good prices are obtained, but when the buyers combine to stifle competition the wool grower invariably receives a low price for his wool.

Six methods are used by wool growers in selling their wool—namely, (1) to buyers representing wool merchants or large mills, (2) local dealers, (3) consignment sales through commission houses, (4) direct to mills located in the vicinity, (5) auction and (6) farmers' co-operative sales agencies.

**78. Wool Merchants.**—The bulk of our wool is sold by the grower to buyers representing wool merchants. These buyers



FIG. 46.—American Wool on Display in the Original Bag.



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FIG. 47.—Wool Warehouse, Lima, Peru.

visit the various ranches and shearing sheds in the West during the shearing season, making the owner offers for his wool. The buying charge against the wool averages the wool merchant about  $\frac{3}{4}$  cent per pound. Some years, when the merchant anticipates high wool prices, the buyer is sent to the ranges to buy the wool on the sheep's back, the owner contracting to deliver the wool when sheared at the agreed price. If the merchant's judgment as to higher values proves correct he frequently saves several cents a pound by this method of buying. As a rule, however, selling wool on the sheep's back is usually regretted by the grower. Boston is the most important wool market in the country, and is followed by Philadelphia, Chicago, New York, St. Louis and Louisville. These cities contain large warehouses where the wool is graded and stored awaiting sale to the mills. Boston has a warehouse capable of holding 100,000,000 pounds of wool, all of which is easily accessible.

The wool merchant is an important factor in our system of marketing wool, and really performs services for the profits secured, in addition to being the middleman between the grower and the manufacturer.

**79. Services Rendered by Wool Merchants.**—The merchant grades the purchased wool in such a manner as to best suit the various mill requirements. Storage facilities are at his command which the grower does not possess. The merchant carries a large assortment of wools, which enables the manufacturer to select the grade which best suits his requirements, and secure immediate delivery, as the principal markets are located near the important manufacturing districts. Furthermore, while the grower receives cash from the merchant for his wool, the merchant often extends the manufacturer considerable credit. The merchant must have a large amount of capital at his command, as the bulk of the wool to be sold for a whole year is bought for cash and received within a period of three months. It sometimes happens that the wool merchant advances money to the wool grower when the latter is short of funds, taking a lien on



FIG. 48.—Australian Wool, Skirted, Classed and Baled on Display at Boston.

the unshorn wool and of course charging interest on the amount loaned. Many wool merchants also sell wool on commission.

In addition to handling domestic wools, many of the larger wool merchants send buyers to the great foreign wool markets, such as London, Liverpool, Sydney, Melbourne, Adelaide, Buenos Aires and Cape Town. The larger wool merchants import large quantities of foreign wools.

Various systems have been suggested for eliminating the wool merchant and establishing direct dealings between the wool grower and the manufacturer. The most prominent systems proposed are wool growers' co-operative associations and large manufacturers' associations to buy wool direct from the growers for the mills holding membership. It is extremely doubtful if any method will become successful enough to entirely eliminate the wool merchant.

**80. Mills Buying Direct.**—Buyers representing large manufacturing units consisting of a number of mills under the same ownership, operate in a similar manner as the buyers representing the wool merchants. If the buyer is capable the mill saves the profit made by the merchant, and on the large amounts of wool required for these mills this saving is a great advantage to the manufacturer.

On the other hand, it would not be profitable for the average mill to send out a buyer to purchase direct from the grower. In many cases the buying expense involved would be greater than the saving secured, and furthermore, few individual mills can command enough capital to pay cash for a year's supply of wool in advance.

**81. Sales to Local Dealers.**—The farmers in the Eastern and Mississippi Valley States usually sell their wool to local dealers in nearby towns. These local dealers usually conduct their wool buying in addition to some other business, usually storekeeping or grain buying. The local dealer is seldom proficient in judging wool and usually pays the same price for all wools offered, irre-

spective of grade and shrinkage. As the farmer seldom knows the quality of the wool produced by his sheep, he is at the mercy of the local dealer, as the quantity grown by the individual farmer is too small to attract the attention of the wool merchant. When the shearing is over in the district the local dealer has usually secured a wide variety of wools. Buyers representing the wool merchant then travel from town to town buying the accumulated wools from the local dealers. In most cases these local dealers turn a handsome profit at the expense of the farmer.

Where wool buying is done in conjunction with storekeeping the local dealer frequently has the farmer at a disadvantage when he sells his wool by having extended considerable credit to the farmer on merchandise, groceries, etc., from the store. It frequently happens that the local dealer is simply the buying agent for some wool merchant who supplies him with buying funds.

**82. Consignment Sales.**—Large wool growers in the West frequently consign their wool to wool commission houses when they are not satisfied with the offers of visiting wool buyers. This enables the grower to hold the wool for a rise in price. The owner places a minimum selling price on his wool. The commission house deducts from the amount received from the sale of the wool all carrying charges, such as storage, grading, freight, hauling, insurance, selling commission, loans to the grower and interest on the same. Many of the wool merchants also handle wools on a commission basis.

**83. Direct Sales to Local Mills.**—The custom in certain sections of the Middle West is to haul the wool grown direct to local mills, or the mills send a representative through the district to buy the wool from the farmers. In many cases, whole or part payment for the wool is made with the products of the mill. This method is to the advantage of both grower and mill, as the farmer secures a slightly higher price from the mill than from the local wool dealer, and the mill is buying cheaper than it can from the wool merchant or local dealer. Such mills buy as much

wool as possible direct from the nearby farmers. Most of the woolen mills buying wool in this manner are scattered through Ohio, Tennessee, Indiana, Michigan, Iowa, Wisconsin and Minnesota. The manufactured products include bed blankets, horse blankets, cassimeres, mackinaws, socks and sweaters.

84. **Sales by Auction.**—Selling wool by auction is sometimes practiced in the sheep-range country. After shearing time all the wool is hauled to town and arranged in various lots to be auctioned off on an advertised date. Buyers representing merchants, commission houses and large mills have been notified in advance of the coming sale, and if interested in the wool offered attend the sale. The auction system, which is the prevailing method of selling wool in London, Liverpool, Australia, New Zealand, South Africa and Continental Europe, has never been popular in the United States.

The New York Wool Exchange was established in 1894 to conduct the sale of our wools in the same manner as cotton is



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FIG. 49.—Wool Teams on the Road, New South Wales, Australia.

marketed. Our American wools were divided into 200 grades by the New York Wool Exchange, but this number proved entirely too small. The Exchange announced auctions, but sellers and buyers failed to appear, and the project was abandoned in less than four years.

The Wyoming Wool Growers' Association built a wool warehouse at Omaha in 1908, and established an auction system, which was abandoned within a year. In 1909 another attempt was made to establish an auction system. The National Wool Warehouse and Storage Company was organized with aid from the National Wool Growers' Association, and built a large warehouse at Chicago. The auctions again failed to attract buyers, but the company changed its plans and has become a successful commission house.

**85. Reasons for Failure of Auctions in United States.**—The reasons for the failure of the auction system in the United States is largely due to the following: The wide variation in American wools; the business habits of our people; sheep raising is not standardized in this country; breeders shift their favor from one breed to another; the lack of grading at the shearing shed; the desire of the American grower and dealer to do their own bargaining with the willingness to "take a chance" and make a large profit. In other words, the trading instinct is prevalent, and our traders lack the conservatism shown by foreign traders, who operate on more secure lines, and are satisfied with a surer and smaller profit.

**86. Farmers' Co-operative Sales Agencies.**—Organizations of this kind have, with varying degree of success, been instituted in upwards of twenty States, but several years must elapse before judgment should be passed as to the success of the movement. The object of such organizations is to take charge of the wool grown by their members, and to sell it in quantities sufficiently large to interest the wool merchant. Inefficient management and members' lack of confidence in the management are the principal

handicaps of this selling method. If up to the present it has accomplished nothing else, it has done a good work along the line of educating wool growers in matters of improving their flocks, giving closer attention to them, sending their clips to market in better condition, and the elimination of the use of sisal twine. They have learned that better returns come from better prepared clips from better sheep.

**87. Comparative Prices (in Cents per Pound) of United States Wool in Boston, 1906-1923.**

OHIO (Unwashed)	1906	1907	1908	1909	1910	1911	1912	1913	1914
XX and X.....	26	27	23	28	22	20	23	20	24
Half blood .....	33	33	26	36	28	25	30	23	27
<b>TERRITORY (Scoured)</b>									
Staple, fine.....	71	73	60	78	65	60	67	54	60
Staple, medium....	66	68	52	70	57	52	60	47	53
Clothing, fine .....	68	65	53	70	58	50	60	48	55
Clothing, medium...	63	60	45	65	50	45	56	43	50
OHIO (Unwashed)	1915	1916	1917	1918	1919	1920	1921	1922	1923
XX and X.....	27	34	58	65	62	57	31	42	55
Half blood .....	36	40	67	78	75	62	33	50	52
<b>TERRITORY (Scoured)</b>									
Staple, fine.....	72	91	160	180	185	155	85	128	130
Staple, medium.....	67	87	155	172	180	150	78	124	125
Clothing, fine.....	68	81	145	170	170	130	70	115	110
Clothing, medium...	69	79	138	165	165	123	64	110	104

**88. Rail and Ocean Freights on Raw Wools.**—As the bulk of our wool is produced in the West, and the great manufacturing districts are located in the East, the freight charges form an item of cost that cannot be slighted; \$2.75 per 100 pounds is a fair estimate for the average transportation of greasy wool from the West to Boston. A special rate of 90 cents for bags, 75 cents for bales and \$1 per 100 pounds applies on all wools shipped to Boston from the Pacific Coast terminals, such as Seattle, Tacoma, Portland, Astoria, San Francisco, Los Angeles and Sacramento. Shipments from Liverpool to Boston range from 30 to 33 cents per 100 pounds, and these prices include dock and shipping charges amounting to about 12 cents per 100. The rates to Bos-

ton from ports in Australia, South Africa and South America are \$3, \$1.90 and \$1.50, respectively. But to these rates must be added the railroad charges in the above-mentioned countries from the ranch to the shipping port. The average railroad charge for hauling wool from interior points to the Australian seaboard is from 65 to 70 cents per 100 pounds.

In South America the average freight rate for grease wool from interior points of Argentina and Uruguay to Buenos Aires is 50 cents. In the southern parts of Argentina the rates are variable, as the wool must be hauled to the coast by ox teams and costs from \$3 to \$7 per 100 pounds.

As a matter of fact, only a small portion of foreign wool is shipped directly from the producing country to the United States; nearly all such wool is first sent to Liverpool and then transhipped to Boston, New York or Philadelphia. Since the opening of the Panama Canal there has been an increase in direct shipments from Australia to our Atlantic seaboard ports.

DISTANCES BY WATER ROUTES FROM IMPORTANT WOOL PORTS TO  
BOSTON AND LONDON

Boston	London	Boston	London		
Bombay .....	7,962	6,280	Hong Kong .....	11,390	9,688
Boston .....	...	3,088	Liverpool .....	2,854	638
Bremen .....	3,377	409	London .....	3,088	...
Buenos Aires .....	5,804	6,294	Melbourne .....	10,200	11,055
Cape Town .....	6,776	6,117	San Francisco ....	5,450	8,039
Constantinople .....	4,820	3,118			

**89. Foreign Wool Auctions.**—The London wool sales are held six times a year, every two months. During the progress of the London sales, the entire quantity of every lot of wool to be sold each day is accessible for examination by the buyers in well-lighted warehouses. Colonial wools are featured at the London sales. Printed catalogues are provided, which give the clip marks and other descriptions marked on the bales. Later in the day the auction sale begins in the salesroom on Coleman Street. It is not unusual to find 100 lots, each averaging 18,000 pounds, sold in fifteen minutes. Every lot is promptly sold to the highest bidder, except such lots as may be withdrawn and the "star



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FIG. 50.—Arrival of Wool Train, Sydney, New South Wales, Australia.

lots." These star lots are composed of one, two or three bales, and are auctioned off after all the larger lots have been disposed of. After the sales, printed catalogues are distributed by the brokers to consigners and purchasers of wools, and a permanent record is thus obtained of every lot sold at auction. London prices practically govern the wool markets of the world.

The Liverpool auctions are conducted and catalogued in the same manner as the London sales. The India wools are featured at the Liverpool sales, but lesser quantities of other foreign wools are also handled. Sales are also conducted in a similar manner in important continental centers such as Antwerp, Hamburg, Bremen, Havre and Marseilles. River Platte wools are featured at Antwerp, while the others auction wools which have been purchased by dealers in the country of origin.

Large quantities of wool known as "off sorts," obtained by skirting, are exceedingly heavy-shrinking. The bulk of such wool is graded and scoured in the country of origin and sold at the European auctions. By forwarding the wool in the scoured condition, a saving is made on transportation charges, and the off sorts are presented for sale in a more attractive condition than would be the case if they were offered in the original greasy condition.

Australia's position as the greatest fine wool-producing country, both for quantity and quality, remains unchallenged. While the natural advantages, such as cheap extensive ranges furnishing green pasturage through the entire year, are very favorable to the wool-growing industry, except when visited by exceptional droughts, nevertheless due credit must be given to the efficient breeding, management and above everything else, the practical and attractive manner in which the wools are prepared for the market. However, the amount of suitable grazing land is limited, as more than half of Australia is dry and barren, without any water supply and practically no rain.

**90. Wool Auctions in Australia.**—In recent years the Australian wool growers have been selling large quantities of their



FIG. 51.—Dalgety's Show Sales Room, Melbourne, Australia.

wools at auction sales conducted in numerous cities throughout the country. These sales are similar to the London sales, with the exception that only ten bales of a lot are opened for examination by prospective bidders. Every year more foreign wool buyers visit Australia to attend these sales. American buyers purchase about 100,000 bales of wool in Australia annually. The chief criticism of the Australian system is that there are too many selling centers. A good plan has been suggested to hold one series of sales in the capital city of each of the six States. The most important Australian wool auctions are conducted at Sydney, Melbourne, Brisbane, Adelaide and Geelong.

When selling in the English market, freight, insurance, storage, dock fees and other charges add from \$5.00 to \$6.00 per bale to the cost of selling. The amount of these charges varies with changes in freight rates, money exchange and the weight of the bales. Another objection is the long delay in receiving the money after the wool has been sold. When selling wool in Australia the wool grower is paid within two weeks after the sale. Although a higher price is obtained at the London sales, the net return to the grower is usually greater and always quicker when the wool is sold in the home markets. It frequently happens that the shipment to London misses the sale for which it was intended. The lot must then wait two months for the next sale. In the meantime storage and insurance charges accumulate, and five or six months may elapse between the shearing of the wool in Australia and the receipt of the returns from London.

In New Zealand six sales are held during November and December, which is the regular selling season. These auction sales are held in Wellington, Napier, Christchurch, Nelson, Timaru and Ivercargill.

**91. Marketing Wools of the British Isles.**—In Scotland wool is seldom sold at annual fairs, but is sent to wool brokers, who usually sell it by auction, and charge a commission of  $2\frac{1}{2}$  per cent. The brokers supply farmers with wool sheets, warehouse the wool, insure it against loss by fire, and issue printed cata-



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FIG. 52.—Display for Wool Sale, Brisbane, Queensland, Australia.

logues to buyers, besides advertising and organizing the sale. These sales take place at certain seasons, and the exact dates are published at the beginning of each year. When necessary, special sales are frequently held between these fixed dates.

In order to obtain the best possible prices for small lots, brokers often grade or class together two or three lots of exactly the same description, and in this way make up a suitable quantity of uniform quality as an extra inducement to big buyers. This practice invariably secures the owners of these small lots a higher price than they would realize if their lots were sold individually. Brokers often effect sales privately, both in their offices and by mailing samples to manufacturers. The system of selling through brokers seems to answer very well where the varieties of wool are not numerous.

Many large wool growers sell direct to wool merchants, and also to American agents. In some districts the tendency toward private sales between farmers and agents seems to be increasing.

The system of selling by auction at a broker's warehouse differs in many ways from selling by auction at a wool fair. A wool merchant must not be confused with a general merchant dealing in wool. General merchants or village shopkeepers in England and Scotland do not now deal in wool. Many years ago they bought wool from local farmers, but the practice was very unsatisfactory and strongly condemned. When the "Truck Act" was passed it almost made it impossible for shopkeepers to buy wool on the old lines, and small farmers have been able to sell their wool at a profit ever since. The difficulties of the small woolen mills in Scotland ceased at the same time.

Originally, all the wool sold at English wool fairs was done by "private bargain," but selling by auction has gradually replaced the old method. There are still some small but important fairs where auction sales have not been adopted, and many buyers would not favor a change. However, it is only a question of time before the auction system becomes general. From a buyer's standpoint there is much to be said in favor of private sales.

When the wool is indifferently classified, or the fleeces irregular, a buyer has a better chance to make an examination and purchase small, odd lots under the price ruling for that day. Brokers also favor the private sales, because unsold lots are handed over to them for disposal. The bulk of the annual clip in England is sold at the wool fairs. Brokers and buying-agents handle but a comparatively small portion.

About two days before the fair the wool is sent or brought to the sale room, placed in order and catalogued. Printed catalogues are generally mailed to buyers who bought at previous sales, but sometimes this is found inconvenient, and they are presented to intending buyers the afternoon preceding the sale day, when the wool is exposed for inspection. For the convenience of buyers who arrive late, the wool is again open for inspection from 6 A. M. until 9 A. M. on the day of sale. Sales usually commence at 10 A. M., but in some cases not until 1 P. M.

The buyers at these sales consist of wool merchants, foreign agents and manufacturers; brokers of course do not buy. The buyers are skilled wool men, well informed on market conditions, and they also possess a thorough knowledge of the requirements of the woolen and worsted industries. While inspecting the wool they mark suitable lots in their catalogues with the price they are disposed to pay, and when these lots are knocked down they enter the selling prices. In this way they feel the pulse of the market soon after the sale begins.

Selling often takes place where the wool is exposed, and you seldom hear several men shouting the same price at the same time. Smaller lots, greater variety and more variations in quality no doubt prevent the "Coleman Street Style" from being duplicated. The auctions in a broker's salesroom closely resemble Coleman Street, because imported as well as home-grown wools are sold there.

In Ireland the system of handling and marketing wool differs considerably from those of either England or Scotland. The country produces a large quantity of wool and a somewhat mixed

variety from every point of view. The leading sheep is the Roscommon, and this breed is not only crossed with down breeds, but is also used for "grading up" several smaller breeds. Farmers also cross other long-wool sheep with downs and hill sheep with long-wool sheep. From a mutton standpoint the Irish crosses are often criticised, because they produce big, fat carcasses, but they usually produce excellent wool. The quantity of wool produced in Ireland increases annually, and the quality has earned a high reputation.

Unfortunately, their auction sales are not numerous, therefore most of the Irish wool is sold privately at the annual fairs. Large growers often sell their wool to agents and merchants before the fairs commence, while others send their whole clip to brokers. Such transactions, however, only represent a small portion of the wool grown in Ireland. English wool merchants are represented at these Irish fairs in large numbers, as are also a few manufacturers. All these buyers have stands in the market, await the arrival of the farmers, and, after the wool is examined and the price agreed upon, it is weighed and the amount immediately paid over in cash.

The fine, soft texture and clean condition of Irish crossbred long wool has created a market of its own, which the manufacturer cannot overlook; therefore the wool merchant can afford to spend a little extra time in matching up and classing. Irish wools yield 5 per cent. more than English, and a considerable portion of the annual clip is exported to the United States.

**92. South American Wool Sales.**—Although direct shipments are made by some large stations to Liverpool and elsewhere, the bulk of the South American wools is sold in Buenos Aires, Bahia Blanco and Montevideo.

The method of handling wool at Buenos Aires differs in some respects from that in other centers; however, the Australian method is supplanting this system. The wool is first exposed for sale in the large market hall, where it is inspected by buyers and speculators, and bought as there shown. Next it is taken to the

warehouse, classed and skirted, and then shipped to Liverpool, whether destined for the English or United States markets. Sorting being too expensive in Buenos Aires, and also somewhat unreliable, is usually done in England. The buying season is from October to March, and the total clip of each season is usually sold within that period.

There is one general feature of marketing wool in South America which differs from the custom of other wool-producing countries. Elsewhere, wools sold in the grease are bought with regard to their probable net yield after scouring, and buyers exercise their own judgment and bid accordingly. South American wools, with few exceptions, are dealt with on a different basis. The sellers take the whole responsibility for the scoured yield. Buyers order grease wool at such a price as will bring the net scoured wool in at a stated cost, and the sellers invoice the greasy wool at the price per pound which they estimate will produce the desired result. So long as they get their net wool at the bargained cost, the invoiced price per pound is a matter of indifference. Large firms in Buenos Aires and Montevideo, which deal on this basis, are prepared to guarantee the net yield under certain conditions. The contracts of the various firms in the chief centers differ in some details, but the form of contract drawn up by the British Association of Wool Buyers, and approved by that body, is the one in general use.

**93. Canadian Wool Situation.**—Canada, with its millions of acres of rich farming lands, does not maintain enough sheep to supply its home demands for mutton and wool. At present the number of sheep in Canada slightly exceeds 2,750,000. For 1913 and 1914 the importations of sheep averaged annually 170,000 head, and the annual wool importations for the same period averaged 9,000,000 pounds.

In the Maritime Provinces and Ontario, only mutton sheep are found. The long-wool breeds are extremely popular and are as numerous as the down breeds. The Province of Ontario is noted for the quality of its sheep, and a specialty is made of raising

high-grade breeding stock. Most of the pure-bred stock offered for sale is purchased by American sheep owners for the improvement of their flocks. Half of the total number of sheep in Canada are to be found in Ontario. The climate during seven months of the year is especially suitable for sheep raising, and is somewhat similar to that of Great Britain. The land is hilly and grass is abundant in Eastern Canada, where the sheep are raised under farming conditions. West of the Province of Ontario to the Pacific Coast, comparatively few sheep are found. In this section, where sheep are maintained, they run the open range, and the methods employed are similar to those used in the Intermountain States of this country. Shelter and winter feeding are a necessity in all parts of Canada, as the winters are severe.

Most of the Western Canadian wool is produced by crossbred Merino sheep in southern Alberta and southwestern Saskatchewan. This district is gradually being taken away from the sheepmen by the heavy influx of settlers. Most of Western Canada is devoted entirely to the production of grains on a large scale. This method of farming is not conducive to the establishment of a sheep industry such as is found where general farming is practiced. Practically no fine wool is produced in Canada. Most of the shortage in mutton is west of Ontario.

In Eastern Canada the shearing is done with common hand shears. The Canadian Government, through the Livestock Branch of the Department of Agriculture, is making a determined effort to increase and improve the mutton and wool production of Canada. The Department has published and widely distributed excellent literature treating all phases of the sheep industry. A staff of wool experts has been sent throughout the country showing the necessity for the better preparation of wool, and demonstrating the proper methods to employ. Their duties furthermore were to visit farmers and ranchers and to instruct them in selection of breeding stock, with the object of improving the breeds. In spite of the extensive educational program, there has been no decided increase in the production of Canadian

wools. There has been an improvement in the preparation of the wool for the market, especially the range wools. Canadian wools contain an excessive amount of vegetable matter, due to careless feeding methods in winter.

In the East practically all the wool is sold by the farmers to local storekeepers, who in turn sell direct to the mills. In some cases manufacturers buy direct from the farmer for cash or woolen goods in exchange. The Western wools are mostly sold through wool growers' co-operative associations. The members send their wool to the association's warehouse, where it is usually graded by experts assigned by the Livestock Branch. In this manner, desirable lots are secured which attract the attention of large buyers. The wool is usually sold at auction, and for a number of years several large wool merchants in Boston have purchased the bulk of the West Canadian wools.

**94. Essential Requirements for Manufacturing.**—A number of important points must be given consideration when the manufacturer purchases wool for the mill. The field of selection is limited by the price the mill can afford to pay for the wool, and this in turn is largely governed by the selling price of the manufactured product. A wool must be chosen within a certain price limit, and it must possess the correct properties to be manufactured into the desired fabric. The essential requirements which the wool should possess are listed below.

1.—The wool should be fine enough to spin to the required counts or numbers of worsted or woolen yarn, and make a strong, smooth and elastic yarn, which will stand up during warping and weaving.

2.—It must be strong enough to withstand the strains imposed on the fiber in the various operations of yarn manufacture, and should not make an excessive amount of noils and waste.

3.—The staple length should be such that the proper finish on the fabric will be possible.

4.—The wool should possess the proper degree of softness or harshness to give the desired feel and handle to the finished fabric.

5.—It should have the proper felting qualities if the fabric is to be fulled in finishing to furnish the desired shrinkage, appearance and handle in the finished goods

6.—Where white is desired for white fabrics or blending with colors to form mixtures, the wool must scour out a clean white.

7.—If dyed, the wool should possess sufficient luster to give brilliancy to the colors.

8.—In conclusion, the wool should possess the general working properties necessary to produce the desired fabric, and to successfully undergo all the processes required for its manufacture with a minimum amount of waste.

## CHAPTER IV

### GRADING AND SORTING

**95. Necessity for Grading.**—Grading is usually performed at the warehouses in this country. The fleeces are taken from the bags and divided into classes, without untying the fleeces, according to the fineness of the wool constituting the greatest bulk of the fleece, and also the length of staple. The latter classification represents the combing and clothing divisions. Off-grades are made where fleeces contain an unusual amount of chaff, burrs, straws, or seeds, and are often indicated by the term "unmerchantable." Such wools are of inferior value, and in many cases must be carbonized to be of use. Other causes for off-grades would be cotted fleeces, patches of black, gray or brown wool, tenderness, kemp, and fleeces with a vile odor shorn from diseased sheep, or decaying carcasses. These last are often known as "rejects."

When the special properties, necessary in wools to make them adaptable for the various fabrics to be manufactured, are borne in mind, the necessity for grading wool can be readily understood. If wools were not graded a worsted mill would probably secure a large quantity of short staple clothing fleeces, which it could not use, in every purchase. The uncertainty as to what a lot contained would make buying even more difficult.

**96. Definition of and Necessity of Sorting.**—Wool sorting is the classification and division of the wool fibers in a fleece into various groups or sorts, according to fineness, length, soundness, elasticity, color, spinning and felting properties. This places all the fibers of a certain grade or fineness, length and general character in one group, and enables that wool to be given processing in the making of the fabrics for which it is best adapted. This would be impossible at times if other grades were mixed with it.

Classing by the wool grower and grading and "standardizing"



Fig. 53.—Grading Fleeces at Warehouse.  
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FIG. 54.—Graded Wool Ready for Sale.

by the wool merchant must not be confused with sorting at the mill. Sorting is absolutely necessary, owing to the great variation in the wool grown on different parts of the fleece. This variation is far more marked in the wool of British breeds of sheep than in any other established breeds. This is especially true in long-wools, lustlers and crossbred types. Merino crossbred wools show less variation, while pure Merinos vary so little that they can almost be used in an unsorted condition after being graded and skirted.

If fleeces were used in their natural state, faulty yarns would result, and the woven cloth would always be imperfect and often unsightly, owing to the impossibility of suiting the subsequent mechanical processes to the various types of wool present in the same lot of stock. Correct sorting yields a profitable series of qualities and enables the maximum value to be obtained from each fleece.

Wool sorting is performed by men, and sometimes women, who are skilled in handling and judging wools by long practice and experience. They determine the sorts by eyesight and the sense of touch. It is possible to sort any fleece into a large number of sorts, and twenty years ago it was not unusual to make a dozen sorts from Merino fleeces. In recent years the tendency has been to make only two, three or four sorts. The number of sorts to be made will depend on the range and character of fabrics made by the mill. In nearly all cases, the sorting is performed at the mill spinning the wool into yarn.

**97. Location of Sorts in Fleece.**—The different parts of the sheep grow wool which varies considerably in fineness and length, and what would grade as  $\frac{1}{2}$  blood fleece often contains every sort from  $\frac{3}{4}$  blood to common. The shoulder furnishes the best wool

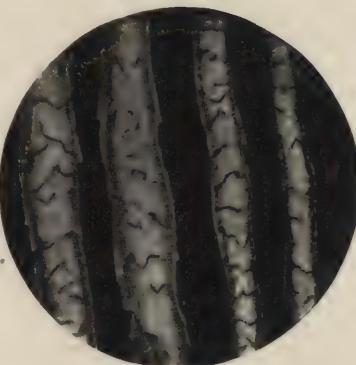
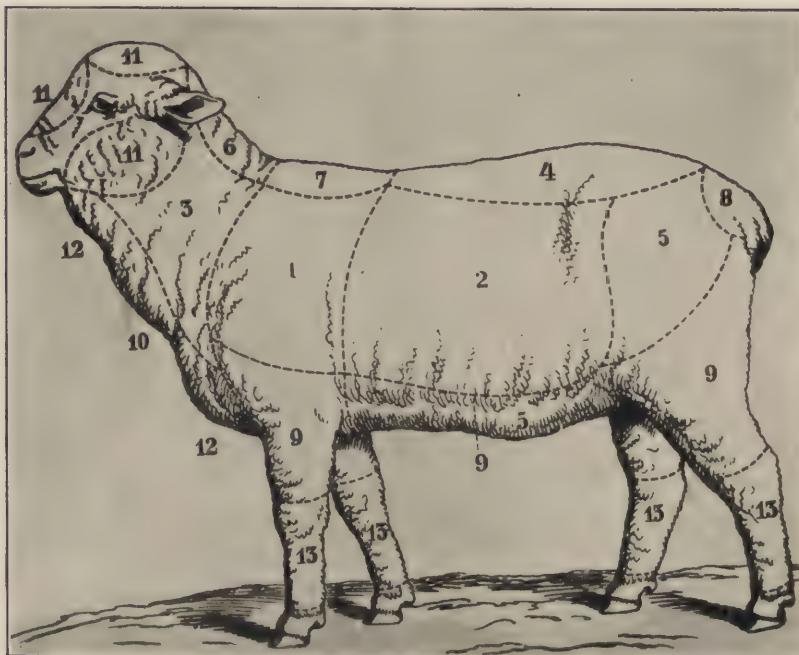


FIG. 55.—Fibers of Lincoln Wool.  
The two fine fibers were taken from  
shoulder and the two coarse  
fibers from the britch.



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FIG. 56.—Illustrating the Many Sorts Possible from One Fleece.

for fineness, strength and length. The sides grow the next best wool, and as the hindquarters are approached the quality decreases considerably until the britch of the sheep is reached, and here the coarsest wool in the fleece is always found. This wool is called "britch." The wool from the back of the sheep follows that from the sides. It is usually a trifle shorter, and particularly in domestic wools often contains chaff and hayseeds. The belly wool is irregular in quality, always short, and frequently uneven and tender. It is often badly stained with urine and contains tags or manure locks. The wool from the head and legs is short, uneven and coarse. In the black-faced breeds the wool from the head is liable to contain some black fibers.

When all these variations and numerous qualities are considered it will be realized that wool sorting is not only a highly intricate and skillful operation, but absolutely necessary for profitable and satisfactory manufacture. The importance of careful classing by the wool grower, and of grading by the wool merchant,



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FIG. 57.—Sorting Wool.

must not be overlooked, as these operations greatly facilitate correct and successful sorting in the mills.

**98. Method of Sorting.**—The sorting is done over a table placed by a light window facing the north if possible. This table has a slatted or wire mesh top, through which dirt, sand, straw, chaff and seeds will fall into a box below when the fleece is shaken by the sorter. A bag of wool is opened, and the strings are cut from twenty or thirty fleeces. The sorter then takes a fleece at a time on the table, shaking it well. The off and low sorts are first removed by tearing them from the rest of the fleece by hand. This is called "skirting" the fleece. These skirtings are placed in a convenient bin or basket alongside the table, and the sorter continues to tear the fleece apart into the required number of sorts, placing each sort in a separate receptacle until the fleece is completed. The main sort varies from 40 per cent. to 80 per cent., according to the requirements of the mill.

**99. Practical Examples of Mill Sorting.**—For the first illustration, a lot of  $\frac{3}{8}$  blood Ohio combing for a worsted mill running exclusively on 2/36 knitting yarn might only be skirted. In that case, the main sort might represent 85 per cent., and the skirting might be divided into a number of sorts, such as britch, shorts and tags, which would be of no use in manufacturing worsted, and would be sold through a dealer or direct to a woolen mill.

Another example is a lot of  $\frac{1}{2}$  blood clothing wool. A number of sorts would be made from the skirting. Assume the mill to be running on a wide variety of fabrics from broadcloths to cloakings. The main part of the fleece might sort as follows: Sort No. 1, shoulders,  $\frac{3}{4}$  blood; Sort No. 2, sides near shoulder, high  $\frac{1}{2}$  blood; Sort No. 3, middle sides, front and middle back,  $\frac{1}{2}$  blood; Sort No. 4, sides and back near hindquarters,  $\frac{3}{8}$  blood. The fine wool is capable of spinning much finer yarn than coarser wools.

Two sorts are frequently made from the same grade of wool on difference in length only, the longer staple going into warp yarn and the shorter into filling, where less strength is required.



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FIG. 58.—Skirting Pieces at Shearing Sheds, Burrawong, New South Wales, Australia.

**100. Skirting.**—The wools of Australia, New Zealand, South Africa and a considerable quantity from South America are skirted and graded as soon as the fleeces are sheared from the sheep. From the edges of the fleece the britch and stained or coarse locks which grow on the belly, legs and neck are removed. Naturally skirted fleeces are more valuable than unskirted ones, and in many mills such skirted fleeces are used entirely as received without sorting, as the bulk of the fleece does not vary enough to require sorting for the yarns and fabrics desired. Our wools, with a few exceptions, come to the market both ungraded and unskirted. Merino fleeces are very uniform in quality, and skirting is about all the sorting usually considered necessary. Coarse fleeces usually show a much wider variation within the fleece.

**101. Mill Methods of Designating Sorts.**—The mills use various numbers and letters to designate the different sorts made in their mills. The following is one of the most common systems for designating quality in worsted mills, the usual equivalent grade term is also given for comparison: 10's is equivalent to  $\frac{3}{4}$  blood; 8's equals  $\frac{1}{2}$  blood; 6's equals  $\frac{3}{8}$  blood, and 4's equals  $\frac{1}{4}$  blood. In designating yarn qualities these terms are used after the count, for example, 2/28/4's, 1/30/6's, 2/40/8's and 2/50/10's.

**102. Illustrating Sorts in Fleece.**—The two diagrams, 59 and 60, represent a domestic fleece grading  $\frac{3}{8}$  blood. Figure 60 shows

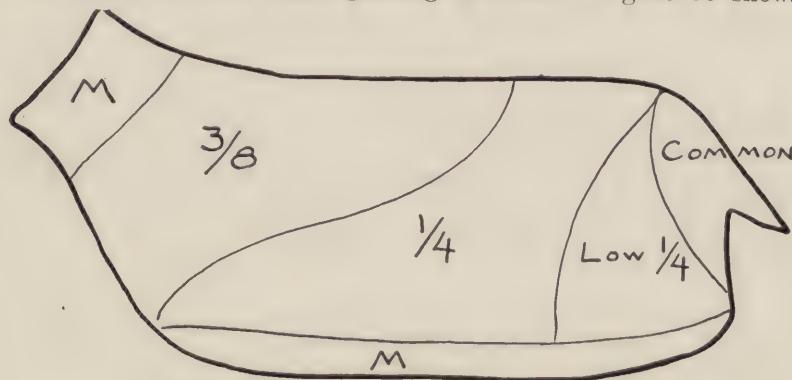


FIG. 59.—Location of Sorts, Side View of Sheep.

the fleece opened out and marked to show the various qualities present. Figure 59 shows a side view of the same fleece as it grows on the sheep.

Figures 61 and 62 at the bottom of this page show the usual main sorts in  $\frac{3}{8}$  blood crossbred and Corriedale fleeces.

**103. Wool Grades—Foreign System.**—The terms used to designate the quality or grade of wool are unfortunately not the same throughout the world. The most widely known is the foreign top makers' system, which is supposed to classify the wool according to the count, number or hank of

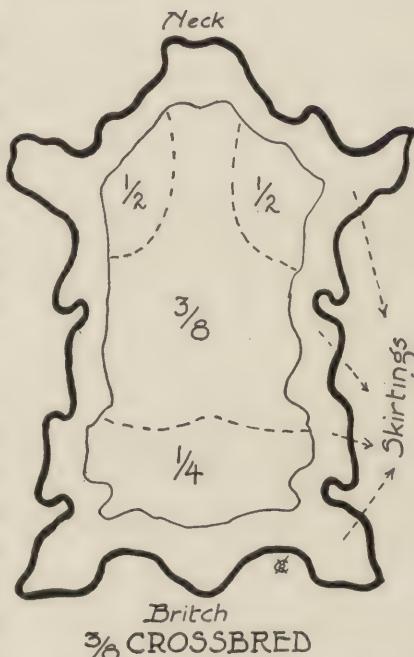


FIG. 60.—Location of Sorts, same as Fig. 59, with Fleece Spread.

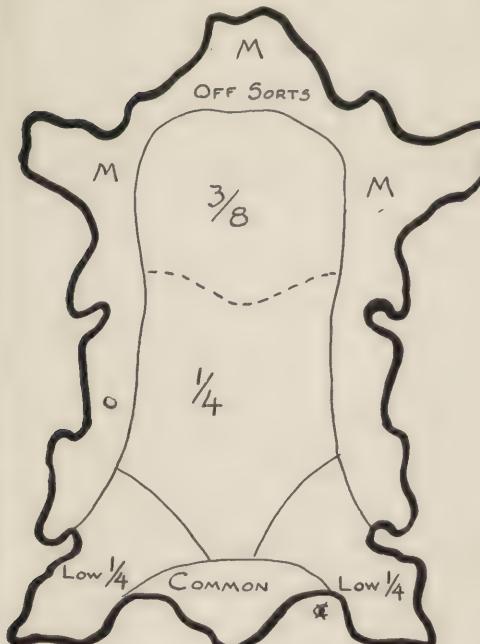


FIG. 61.—Main Sorts in Three-eighths Crossbred Fleece.

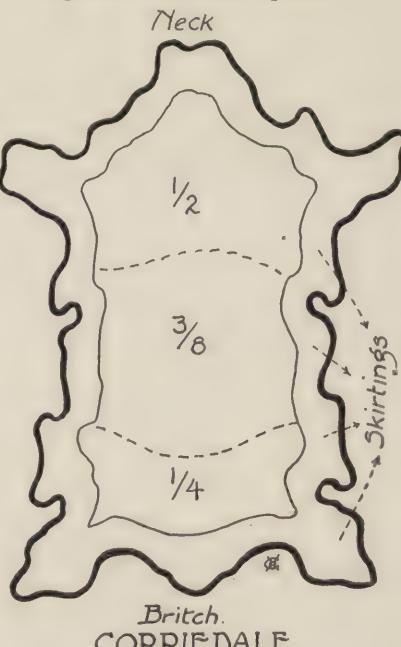


FIG. 62.—Main Sorts in Corriedale Fleece.

worsted yarn, which could be spun from the wool. For example, 50s quality crossbred wool could be spun to a single 50s worsted yarn, which means that one pound of the yarn would contain 50 times 560 yards, a worsted hank, or 28,000 yards. This system is used in Great Britain, Continental Europe, Australia, New Zealand, South Africa and South America. The numbers are misleading, as the higher numbers spin finer than the designated number, and the lower ones will not spin up to their number. Owing to climatic conditions, the same quality tops can be spun a few numbers finer in England than in America.

**104. Wool Grades—American System.**—The American classification was originally based on the wool from a full-blooded Merino sheep as the standard of fineness, and the other grades arranged according to the amount of Merino blood present. In this method, the wool from a half-blood sheep would be twice as coarse as the wool from a full-blood Merino sheep. While the grade terms are still retained they do not carry the former meaning. The grade terms, “ $\frac{1}{2}$  blood,” “ $\frac{3}{8}$  blood,” etc., simply indicate the relative fineness or diameter of the fibers, and bear no relationship to the amount of Merino blood present in the sheep producing the wool. Many  $\frac{1}{2}$  blood,  $\frac{3}{8}$  blood and  $\frac{1}{4}$  blood wools are grown by sheep containing no trace of Merino blood.

There is no fixed measure to determine the grades, such as a foot-rule for length and scales for weight. The grades are established by custom and experience, and very often what one sorter calls a  $\frac{3}{8}$  blood wool would be a low  $\frac{1}{2}$  blood to another sorter. One familiar with wools has the relative fineness of each grade pictured in his mind, and often finds wool which is just short of his requirement for a straight grade, or a little above it. In such cases, the wool would be graded as low or high  $\frac{1}{2}$  blood or whatever may be the nearest straight grade. The requirements of each grade vary slightly in different wool centers. Boston is known as the highest grading wool market in the world. In other words, the Boston ideas of a grade are slightly higher or finer than the requirements of other wool centers.

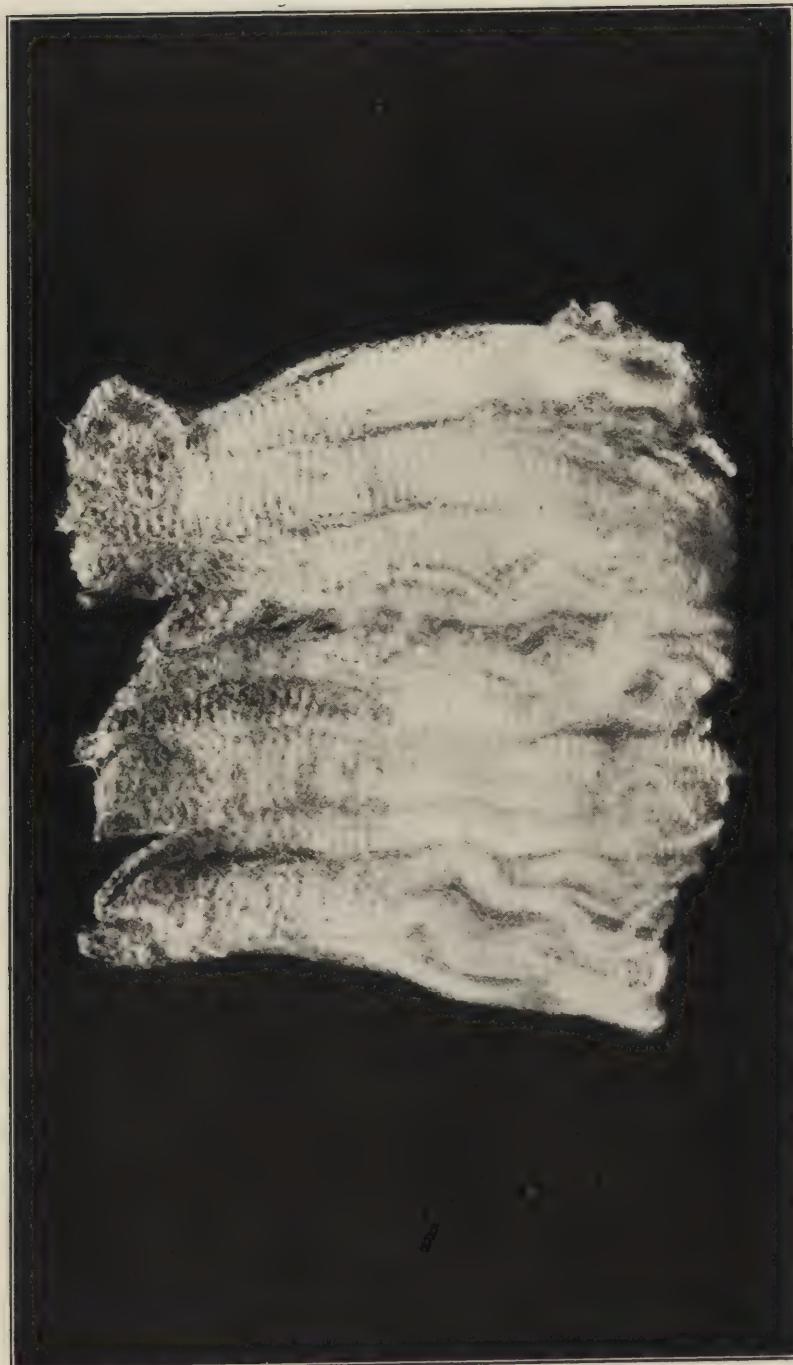


FIG. 63.—XX Combing Wool.

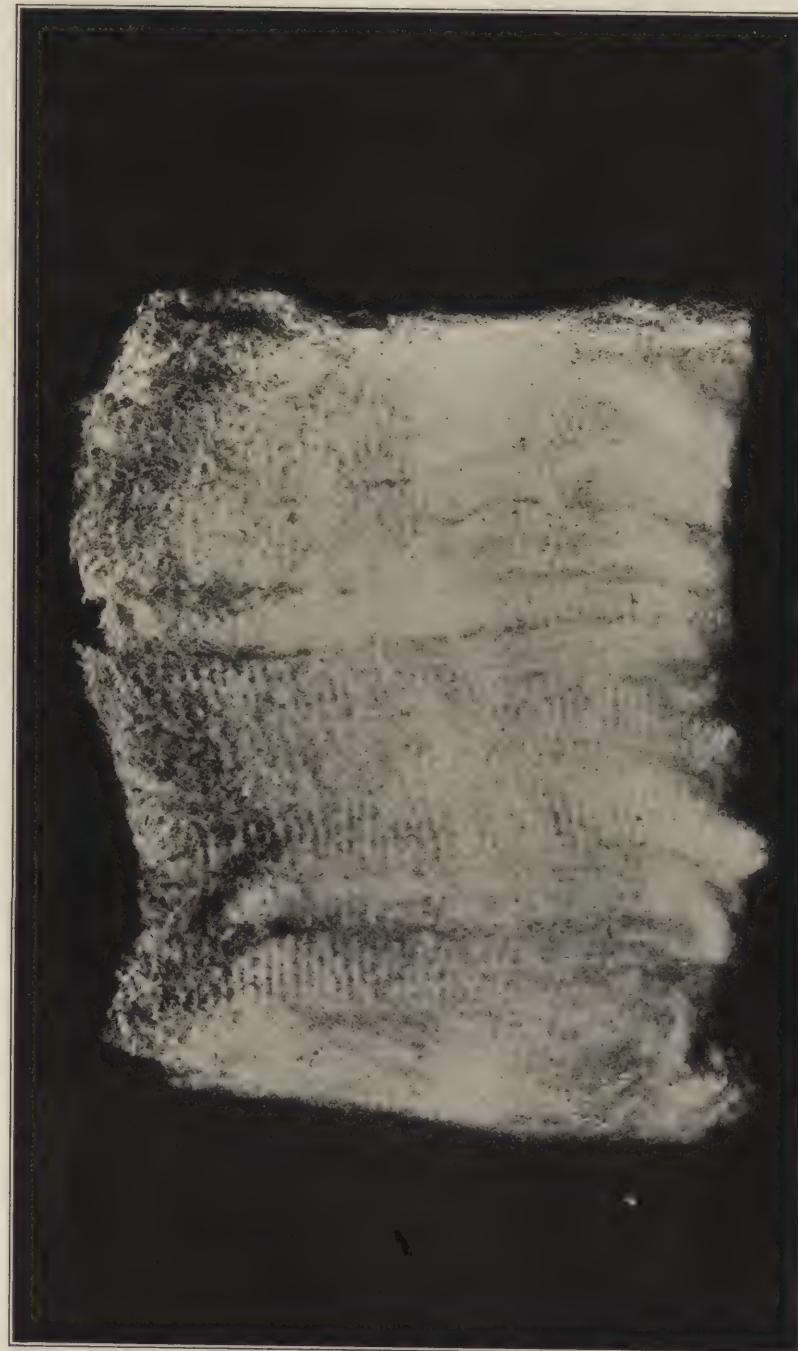


FIG. 64.—Half Blood Combing Wool.



FIG. 65.—Three-eighths Blood Combing Wool.

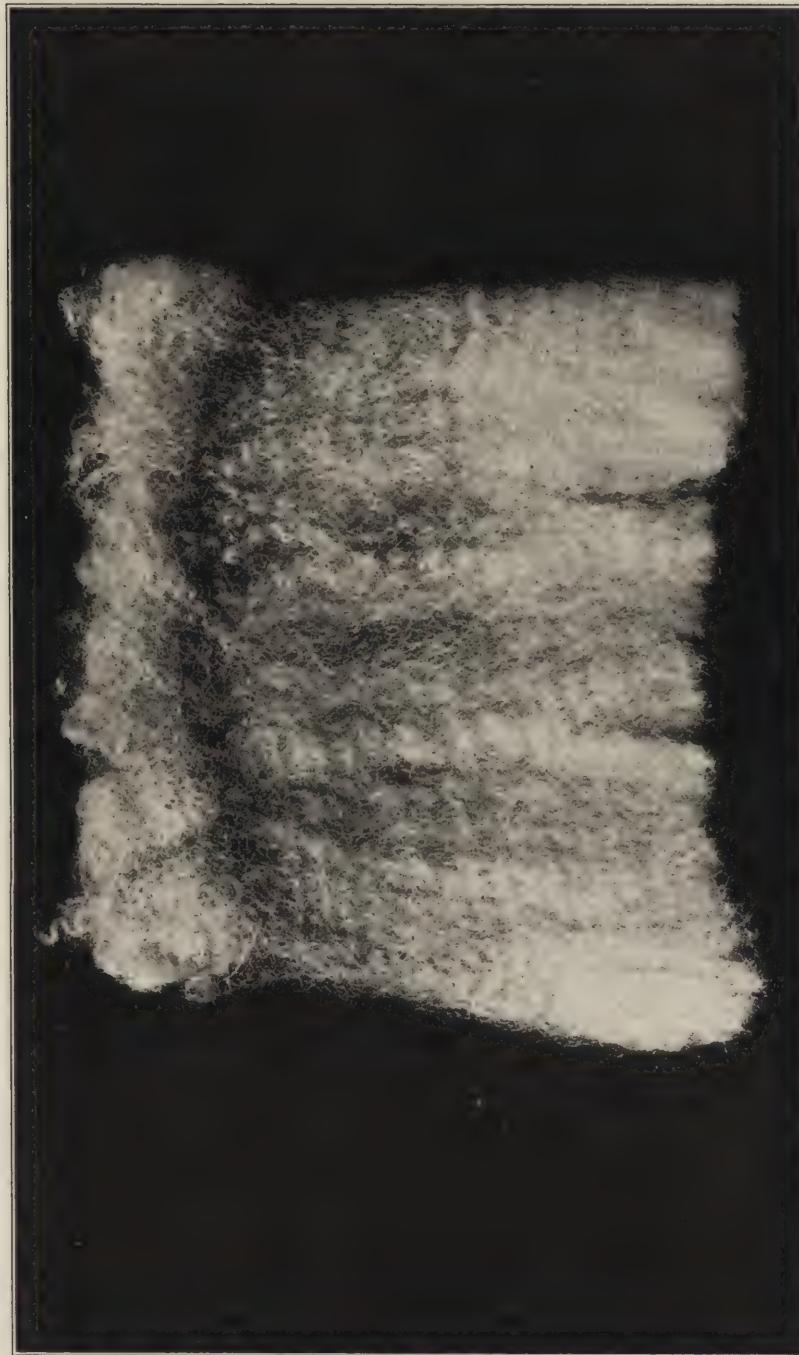


FIG. 66.—Quarter Blood Combing Wool.



FIG. 67.—Common Combing Wool.



FIG. 68.—Braid Wool.

The lower grades of domestic and territory wools are named alike, but the finer grades carry different names in the two classes. Pulled wools, which are obtained from the pelts of slaughtered sheep, are graded by letters, and cannot be sorted as closely as fleece wools.

**105. Comparative Grades.**—The following table shows the American domestic grades, together with the equivalent territory, pulled wool, Canadian, and foreign grades, with the counts usually spun from the foreign top makers' grades in the United States. Both combing and clothing wools grade the same; the terms "combing" and "clothing" are used with the grade term to distinguish them. There is a more marked distinction between the low grades than the fine grades.

An important distinction also exists between lambs' wool and that from sheep two or more years old. The lambs' wool is naturally pointed at the end, as it has never been clipped, and a number of fibers are usually grouped in a pointed lock at their tips. The first fleece clipped from a sheep is also known as hog, hogget or teg wool, and it will spin finer than other fleece wools of similar quality.

U. S. Domestic	U. S. Territory	U. S. Pulled Wool	Counts Spun in U. S.
Full blood (XX).....	Fine .....	AA	66s-74s 60s
Three-quarter blood (X)...	Fine medium .....	AA	60s-66s 50s
One-half blood .....	Medium .....	A	54s-60s 40s
Three-eighths blood .....	Three-eighths blood :..	B	48s-54s 36s
One-quarter blood .....	One-quarter blood .....	B	44s-48s 32s
Low one-quarter blood.....	Low $\frac{1}{4}$ blood .....	C	40s-44s 20s
Common .....	Common .....	C	36s-40s 16s
Braid .....	Braid .....	C	32s-36s 16s

Oregon wools are divided into Eastern and Valley, and the grades No. 1, No. 2 and No. 3 are equivalent respectively to  $\frac{1}{2}$ ,  $\frac{3}{8}$  and  $\frac{1}{4}$  blood for the Valley wools which are grown in Western Oregon. Most of the Oregon wool is produced in the eastern part of the State, and is typical territory wool with heavy shrinkage. Eastern No. 1, No. 2 and No. 3 correspond with the territory grade terms fine, fine medium and medium, respectively.

**106. Estimated Percentage of Various United States Wools.**—The estimated percentages of the various qualities of wool grown in the United States are shown below:

United States	Fine and Fine Medium	Half Blood Wools	% Blood and Below
Entire country .....	52 per cent.	17 per cent.	31 per cent.
Territory wools .....	66 per cent.	22 per cent.	12 per cent.
Domestic wools .....	23 per cent.	8 per cent.	69 per cent.

**107. Market Quotations.**—A list of typical market quotations will be found in the appendix, on pages 228-230. An excellent idea can be obtained as to the descriptions and grades usually quoted as well as comparative values.

**108. Sorting Tests.**—A lot of  $\frac{3}{8}$  blood territory clothing (Wyoming) weighed 810 pounds net, and yielded three sorts according to the requirements of the mill.

No. 1 Sort, main sort, $\frac{3}{8}$ blood.....	606 lbs.	74.8%
No. 2 Sort, high $\frac{3}{8}$ blood .....	35 lbs.	4.3%
No. 3 Sort, low sort, $\frac{1}{4}$ blood and common.....	125 lbs.	15.5%
Loss in sorting (sand, etc.) .....	44 lbs.	5.4%
 Total .....	 810 lbs.	 100%

**Lot No. 2.**—A mixed lot of territory wool weighing 3577 pounds net was sorted in the following manner:

No. 1 Sort, first main sort, $\frac{3}{8}$ blood staple.....	914 lbs.	25.5%
No. 2 Sort, second main sort, $\frac{3}{8}$ blood clothing.....	1,531 lbs.	42.8%
No. 3 Sort, $\frac{1}{4}$ blood clothing .....	358 lbs.	10.0%
No. 4 Sort, shorts, low $\frac{1}{4}$ blood clothing.....	381 lbs.	10.7%
No. 5 Sort, skirtings, low and irregular .....	265 lbs.	7.5%
Loss in sorting (sand, etc.) .....	128 lbs.	3.5%
 Total .....	 3,577 lbs.	 100%

**Lot No. 3.**—Two bales of  $\frac{3}{8}$  blood Australian crossbred combing wool (skirted) weighed 570 pounds net:

No. 1 Sort, $\frac{1}{2}$ blood combing .....	9 lbs.	1.60%
No. 2 Sort, $\frac{3}{8}$ blood combing .....	553 lbs.	97.00%
No. 3 Sort, $\frac{1}{4}$ blood combing .....	2 lbs.	.35%
No. 4 Sort, shorts .....	1 lb.	.17%
Loss in sorting .....	5 lbs.	.88%
 Total .....	 570 lbs.	 100%

*Lot No. 4.*—Close sorting of a bag of Montana wool, grading as  $\frac{1}{2}$  blood staple, resulted in a greater number of sorts. The gross weight was 245 pounds; weight of bag 4.5 pounds; net weight of wool 240.75 pounds.

Regular Sorts	Weight—Pounds	Percentage	Value Per Lb. in Cents Spring, 1914
X or three-quarter blood staple.....	11.21	4.66	21.0
One-half blood staple .....	88.69	36.84	22.7
One-half blood clothing .....	12.90	5.36	21.6
Three-eighths blood staple .....	64.76	26.90	23.0
Three-eighths blood clothing .....	24.33	10.11	20.0
One-quarter blood staple .....	12.90	5.36	19.0
One-quarter blood clothing .....	4.55	1.89	17.0
Low one-quarter blood staple .....	.55	.23	16.0
Off Sorts			
Stained and gray .....	.55	.23	14.0
Shorts .....	3.90	1.62	10.0
Fibers .....	3.32	1.38	5.0
Tags and clips .....	2.76	1.15	1.0
String .....	1.37	.57	.5
Loss in sorting .....	8.90	3.70	...
Total .....	240.75 lbs.	100%	—



FIG. 69.—Range Scene, Wyoming.

**109. Grades of Wool from Various Breeds of Sheep.**—While it is impossible to assign a fleece to a particular grade solely upon the basis of the breeding of the sheep, nevertheless in a general way the various breeds grow wools of a definite quality. In the mutton breeds particularly there are wide variations within a single breed and within flocks. The following list shows in a general way how fleeces from the various breeds would grade:

Breed	Usual Grade of Wool Produced
Merino (domestic) .....	XX and X clothing and combing
Merino (Delaine) .....	XX and X combing
Merino (territory) .....	Fine and fine medium clothing and staple
Merino (Rambouillet) .....	XX and X combing and clothing and a small amount of $\frac{1}{2}$ blood
Crossbred: Longwool on Merino.....	$\frac{1}{2}$ , $\frac{3}{8}$ and $\frac{1}{4}$ blood combing
Crossbred: Medium wool on Merino.....	$\frac{3}{4}$ , $\frac{1}{2}$ and $\frac{3}{8}$ blood combing or clothing
Lincoln .....	Low $\frac{1}{4}$ blood combing or braid
Leicester .....	Low $\frac{1}{4}$ blood combing or braid
Cotswold .....	Low $\frac{1}{4}$ blood combing or braid
Romney .....	Low $\frac{1}{4}$ blood combing or braid
Roscommon .....	Low $\frac{1}{4}$ blood combing or braid
Corriedale .....	$\frac{3}{8}$ blood combing
Southdown .....	$\frac{1}{2}$ and $\frac{3}{8}$ blood clothing
Shropshire .....	Mostly $\frac{3}{8}$ blood, some $\frac{1}{4}$ blood combing or clothing
Hampshire .....	$\frac{3}{8}$ and $\frac{1}{4}$ blood clothing
Oxford .....	$\frac{1}{4}$ and low $\frac{1}{4}$ blood combing
Dorset Horn .....	$\frac{3}{8}$ and $\frac{1}{4}$ blood clothing
Cheviot .....	$\frac{1}{4}$ blood combing
Tunis .....	Low $\frac{1}{4}$ blood combing

#### OFFICIAL STANDARD WOOL GRADES

After several years of work, officials of the Bureau of Agricultural Economics submitted to the Secretary of Agriculture under date of May 7, standard grades of wool which, if he approved, he had the right to establish and promulgate as the official wool standards. This he did on July 13, after approving them on May 18, to be effective as of July 1, 1923. The various grades are defined under eight sections, as follows:

Section 1. Grade fine.—Fine shall be wool which in diameter of fiber is not greater than the sample marked "fine" of a series of samples in the custody of the United States Department of

Agriculture in the District of Columbia in a container marked "original official wool standards of the United States, grades."

Section 2. Grade one-half blood.—One-half blood shall be wool which in diameter of fiber is greater than the sample marked "fine" but not greater than the sample marked "one-half blood" of a series of samples in the custody of the United States Department of Agriculture in the District of Columbia in a container marked "original official wool standards of the United States, grades."

Section 3. Grade three-eighths blood.—Three-eighths blood shall be wool which in diameter of fiber is greater than the sample marked "one-half blood" but not greater than the sample marked "three-eighths blood" of a series of samples in the custody of the United States Department of Agriculture in the District of Columbia in a container marked "original official wool standards of the United States, grades."

Section 4. Grade one-fourth blood.—One-fourth blood shall be wool which in diameter of fiber is greater than the sample marked "three-eighths blood" but not greater than the sample marked "one-fourth blood" of a series of samples in the custody of the United States Department of Agriculture in the District of Columbia in a container marked "original official wool standards of the United States, grades."

Section 5. Grade low one-fourth blood.—Low one-fourth blood shall be wool which in diameter of fiber is greater than the sample marked "one-fourth blood" but not greater than the sample marked "low one-fourth blood" of a series of samples in the custody of the United States Department of Agriculture in the District of Columbia in a container marked "original official wool standards of the United States, grades."

Section 6. Grade common.—Common shall be wool which in diameter of fiber is greater than the sample marked "low one-fourth" but not greater than the sample marked "common" of a

series of samples in the custody of the United States Department of Agriculture in the District of Columbia in a container marked "original official wool standards of the United States, grades."

Section 7. Grade braid.—Braid shall be wool which in diameter of fiber is greater than the sample marked "common" and which approximates the sample marked "braid" of a series of samples in the custody of the United States Department of Agriculture in the District of Columbia in a container marked "original official wool standards of the United States," grades.

Section 8. For the purposes of grading. —Wool in the fleece shall be designated by the grade of the largest proportion of the fibers of the fleece.

## CHAPTER V

### SHRINKAGE

**110. Cause of Shrinkage.**—Before wool can be processed into yarn it is necessary to remove, by scouring, the grease and foreign matter present. The grease and foreign matter represent the loss or shrinkage, and have been described in detail in the first chapter under the heading "Grease and Foreign Matter." The question of shrinkage is one of the most important phases connected with the buying and manufacture of wool. The amount of loss or shrinkage is figured as a certain percentage of the original grease weight of the wool. For example, a shrinkage of 60 per cent. would mean that 100 pounds of grease wool would only yield 40 pounds of clean or scoured wool.

There is a wide variation, ranging from 25 per cent. to 80 per cent., in the shrinkage of various wools grown in this country. As a general rule, the fine grades are the heaviest shrinking. Short wools shrink from 2 per cent. to 3 per cent. more than longer wools of similar character. The main factors influencing the amount of shrinkage are, first, the breed of sheep, which in turn largely governs the grade of wool grown; second, the character of the soil; third, climatic conditions, and fourth, the care given the flocks.

**111. Shrinkage Affects Value.**—After determining the quality of the wool under consideration the buyer estimates the shrinkage, and while the wool is bought at a certain price per grease pound, this price is determined from the price at which the buyer values the scoured wool. The shrinkage is a total loss to the mill, except where the solvent process is used (see Paragraph 27), and the mill must figure the cost of its finished product on the cost of the scoured wool. In most cases the wool buyer has to depend solely on his judgment, after carefully examining and

handling the wool, as to the amount of shrinkage. In addition to examining the wool the buyer is aided in estimating the shrinkage by knowing the average amount of shrinkage for the section for a number of years back, also the weather conditions, such as an open or severe winter, sand storms, drought, etc., and something of the breeding of the sheep producing the wool under consideration, as well as the care given the sheep by the owner. It is the business of the buyer to possess this information, which guides him in estimating the shrinkage. As a rule, wool buyers become so proficient in this respect that they usually come within 1 per cent. of their estimated shrinkage.

**112. Sample Lots Scoured to Ascertain Yield.**—After the wool is received at the warehouses and graded the dealers frequently have sample lots scoured at a custom scouring plant in order to check up the estimated shrinkage. In many cases before buying from dealers the mills scour a sample lot consisting of one or more bags, as a test to determine the shrinkage, so the scoured cost of the wool will be definitely known.



FIG. 70.—Wool Scouring Machinery.

Tests on the same lot of wool often vary from 1 to 3 per cent. One test lot may not be thoroughly cleaned. The principal cause of difference, however, is the condition of the wool when weighed after drying. If the scoured wool is weighed immediately after drying it will naturally weigh less than the same lot after standing several hours and regaining moisture. The first is known as a "hot test" and the latter as a "cold test." Naturally the shrinkage figures higher with a hot test.

**113. Practical Illustrations.**—As practical illustrations showing the variation in shrinkage for different grades and wools some of the "sorting tests" from the preceding chapter are given below. All the sorts were allowed to stand overnight after drying in order to furnish cold tests.

*Test Lot No. 1.*—810 pounds sorted (loss in sorting 44 pounds):

% Blood	Territory	Clothing	Grease Weight	Scoured Weight	Per Cent. Shrinkage
		(Wyoming)			
No. 1 Sort, main sort, $\frac{3}{8}$ blood			606 lbs.	316 lbs.	47.9%
No. 2 Sort, high $\frac{3}{8}$ blood			35 lbs.	15 lbs.	57.1%
No. 3 Sort, low sort, $\frac{1}{4}$ blood and common			125 lbs.	70 lbs.	44.0%
Total			766 lbs.	401 lbs.	50.5%*

\* Average percentage.

810 lbs. total grease weight.

401 lbs. total clean weight.

409 lbs. total loss in sorting and scouring.

409 of 100% = 50.5% average shrinkage from bag.

810

In order to find the clean cost per pound of the main sort a value must be estimated for the minor sorts. In placing a value on lots of this kind care must be taken not to place too high a figure on them, and by so doing cause the main sort to figure at a much lower cost than it should. It is far safer to be conservative and undervalue the minor sorts.

Consider the cost of the original wool at 35 cents per pound. The total cost of the wool amounts to  $\$.35 \times 810 = \$283.50$ .

The value of No. 2 Sort is estimated at 75 cents per pound clean, and No. 3 Sort is placed at 60 cents.

$$\begin{aligned} \$0.75 \times 15 &= \$11.25 \text{ total clean cost No. 2 Sort.} \\ \$0.60 \times 70 &= \$42.00 \text{ total clean cost No. 3 Sort.} \end{aligned}$$

\$53.25 combined clean cost of minor sorts.

\\$283.50 purchase price of lot.

\\$53.25 combined clean cost No. 2 and No. 3 Sorts.

\\$230.25 cost of main sort, divided by 316 lbs., makes the clean cost per pound \\$7.29.

The average clean cost per pound for the entire lot is quickly found by dividing the purchase amount by the scoured weight of the lot. In this case it would be \\$283.50 divided by 401 pounds, giving \\$.707 as the average clean cost per pound for the entire lot. It must be remembered that these figures do not include any of the expense incurred by sorting, scouring and general expense. These charges are manufacturing costs and are kept separate from the cost of the wool. The sorting cost ranges from one-third of a cent to two cents per grease pound, according to the number and character of sorts required and the condition of the wool. The sorting cost is usually under a cent per pound. The scouring cost approximates  $\frac{1}{2}$  cent per scoured pound.

*Test Lot No. 2.*—The second illustration is the mixed lot of territory wool. The net weight from the bag is 3577 pounds, and the mill paid 32 cents per pound:

	Grease Weight	Scoured Weight	Per Cent. Shrinkage
No. 1 Sort, first main sort, $\frac{3}{8}$ blood staple	914 lbs.	490 lbs.	46.4%
No. 2 Sort, second main sort, $\frac{3}{8}$ blood clothing	1,531 lbs.	750 lbs.	51.0%
No. 3 Sort, $\frac{1}{4}$ blood clothing	358 lbs.	195 lbs.	45.5%
No. 4 Sort, off sort, shorts, low $\frac{1}{4}$ blood clothing	381 lbs.	180 lbs.	52.7%
No. 5 Sort, skirtings, irregular	265 lbs.	95 lbs.	64.2%
Total	3,449 lbs.	1,710 lbs.	52.2%*

\* Average percentage from bag.

The loss of weight in sorting and scouring was 1867 pounds, which makes the average shrinkage for the lot 52.2 per cent. This lot of wool cost the mill \$1144.64, which when divided by

the total weight of the scoured wool makes the clean cost per pound \$.669.

When the percentage of shrinkage and grease cost per pound are known, the quickest and easiest method of finding the clean cost per pound is to deduct the percentage of shrinkage from 100 per cent., the remainder being the percentage of scoured wool. Next divide this percentage into the grease cost per pound, and this multiplied by 100 per cent. gives the clean cost per pound. It is self-evident that a 25-cent wool shrinking 50 per cent. will cost 50 cents scoured. The five-sort lot above, with an average shrinkage of 52.2 per cent., and costing 32 cents per pound in the grease, makes a better illustration of the method; 100 per cent., less 52.2 per cent. shrinkage, gives 47.8 per cent. clean wool or yield; \$.32 divided by the 47.8 per cent. and multiplied by 100 per cent. makes the clean cost per pound \$.669. This is the same cost as found by the first method, which divided the total cost by the total scoured weight.

In other words, the original grease pound has been reduced to .478 pound and therefore the original cost of \$.32 now represents .478 pound. It takes  $2.09 +$  grease pounds to make one scoured pound;  $$.32 \times 2.09 +$  gives \$.669 again as the clean cost per pound.

*Test Lot No. 3.*—The 570-pound test lot of  $\frac{3}{8}$  blood Australian crossbred combing cost 47 cents per pound and the sorts scoured as follows:

	Grease Weight	Scoured Weight	Per Cent. Shrinkage
No. 1 Sort, $\frac{1}{2}$ blood combing .....	9 lbs.	5.20 lbs.	42.2%
No. 2 Sort, $\frac{3}{8}$ blood combing .....	553 lbs.	350.00 lbs.	36.7%
No. 3 Sort, $\frac{1}{4}$ blood combing .....	2 lbs.	1.32 lbs.	34.0%
No. 4 Sort, shorts .....	1 lb.	.52 lb.	48.0%
Total .....	565 lbs.	357.04 lbs.	37.36%*

\* Average percentage.

The average shrinkage from the bale was 37.36 per cent. and the clean cost \$.7505 per pound.

**114. Table Giving Grease and Scoured Price Per Pound.**—The following table clearly shows the influence of shrinkage on prices. The prices at the top represent the cost per pound of scoured wool, and range from 40 to 70 cents covering all ordinary cases. The first column to the left gives the percentages of shrinkage, running from 55 per cent. to 75 per cent. This will cover practically all wools grown in the United States. To find the grease cost of a wool shrinking 60 per cent. and valued at 48 cents per scoured pound, follow the 60 per cent. line to the 48-cent column, and the grease price per pound is found to be 19.2 cents. On the other hand, if the grease value and shrinkage are known, the clean value can be found just as quickly.

#### SHRINKAGE TABLES

Clean Values on Top Line, Shrinkages at Right and Left, Grease Price  
Opposite Shrinkage

Clean	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	%
Price	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	55	55	55	
55	18.0	18.4	18.9	19.3	19.8	20.2	20.7	21.1	21.6	22.0	22.5	22.9	23.4	23.8	24.3	24.7	55	55	55	
56	17.6	18.0	18.5	18.9	19.4	19.8	20.2	20.7	21.1	21.6	22.0	22.4	22.9	23.3	23.8	24.2	56	56	56	
57	17.2	17.6	18.1	18.5	18.9	19.3	19.8	20.2	20.6	21.1	21.5	21.9	22.4	22.8	23.2	23.7	57	57	57	
58	16.8	17.2	17.6	18.1	18.5	18.9	19.3	19.7	20.2	20.6	21.0	21.4	21.8	22.3	22.7	23.1	58	58	58	
59	16.4	16.8	17.2	17.6	18.0	18.4	18.9	19.3	19.7	20.1	20.5	20.9	21.3	21.7	22.1	22.6	59	59	59	
60	16.0	16.4	16.8	17.2	17.6	18.0	18.4	18.8	19.2	19.6	20.0	20.4	20.8	21.2	21.6	22.0	60	60	60	
61	15.6	16.0	16.4	16.8	17.2	17.5	17.9	18.3	18.7	19.1	19.5	19.9	20.3	20.7	21.1	21.5	61	61	61	
62	15.2	15.6	16.0	16.3	16.7	17.1	17.5	17.9	18.2	18.6	19.0	19.4	19.8	20.1	20.5	20.9	62	62	62	
63	14.8	15.2	15.5	15.9	16.3	16.6	17.0	17.4	17.8	18.1	18.5	18.9	19.2	19.6	20.0	20.3	63	63	63	
64	14.4	14.8	15.1	15.5	15.8	16.2	16.6	16.9	17.3	17.6	18.0	18.4	18.7	19.1	19.4	19.8	64	64	64	
65	14.0	14.3	14.7	15.1	15.4	15.7	16.1	16.4	16.8	17.1	17.5	17.9	18.2	18.6	18.9	19.3	65	65	65	
66	13.6	13.9	14.3	14.6	15.0	15.3	15.6	16.0	16.3	16.7	17.0	17.3	17.7	18.0	18.3	18.7	66	66	66	
67	13.2	13.5	13.9	14.2	14.5	14.8	15.2	15.5	15.8	16.2	16.5	16.8	17.2	17.5	17.8	18.2	67	67	67	
68	12.8	13.1	13.4	13.7	14.1	14.4	14.7	15.0	15.4	15.7	16.0	16.3	16.6	17.0	17.3	17.6	68	68	68	
69	12.4	12.7	13.0	13.3	13.6	13.9	14.3	14.6	14.9	15.2	15.5	15.8	16.1	16.4	16.7	17.1	69	69	69	
70	12.0	12.3	12.6	12.9	13.2	13.5	13.8	14.1	14.4	14.7	15.0	15.3	15.6	15.9	16.2	16.5	70	70	70	
71	11.6	11.9	12.2	12.5	12.8	13.0	13.3	13.6	13.9	14.2	14.5	14.8	15.1	15.4	15.7	16.0	71	71	71	
72	11.2	11.5	11.8	12.0	12.2	12.6	12.9	13.1	13.4	13.7	14.0	14.3	14.6	14.8	15.1	15.4	72	72	72	
73	10.8	11.0	11.3	11.6	11.9	12.1	12.4	12.7	13.0	13.2	13.5	13.8	14.0	14.3	14.6	14.9	73	73	73	
74	10.4	10.6	10.9	11.2	11.4	11.7	11.9	12.2	12.5	12.7	13.0	13.3	13.5	13.8	14.0	14.3	74	74	74	
75	10.0	10.2	10.5	10.7	11.0	11.2	11.5	11.8	12.0	12.2	12.5	12.8	13.0	13.2	13.5	13.8	75	75	75	

NOTE: Higher prices may be found as multiples of the figures in this table.

SHRINKAGE TABLES—*Continued*

Clean	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	%
Price	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71			
55	25.2	25.6	26.1	26.5	27.0	27.4	27.9	28.3	28.8	29.2	29.7	30.1	30.6	31.0	31.5	31.9	55		
56	24.6	25.1	25.5	26.0	26.4	26.8	27.3	27.7	28.2	28.6	29.0	29.4	30.0	30.4	30.8	31.2	56		
57	24.1	24.5	24.9	25.4	25.8	26.2	26.7	27.1	27.5	28.0	28.4	28.8	29.2	29.7	30.1	30.5	57		
58	23.5	23.9	24.4	24.8	25.2	25.6	26.0	26.5	26.9	27.3	27.7	28.1	28.6	29.0	29.4	29.8	58		
59	23.0	23.4	23.8	24.2	24.6	25.0	25.4	25.8	26.2	26.7	27.1	27.5	27.9	28.3	28.7	29.1	59		
60	22.4	22.8	23.2	23.6	24.0	24.4	24.8	25.2	25.6	26.0	26.4	26.8	27.2	27.6	28.0	28.4	60		
61	21.8	22.2	22.6	23.0	23.4	23.8	24.2	24.6	25.0	25.4	25.7	26.1	26.5	26.9	27.3	27.6	61		
62	21.3	21.7	22.0	22.4	22.8	23.2	23.6	23.9	24.3	24.7	25.1	25.5	25.8	26.2	26.6	26.9	62		
63	20.7	21.1	21.5	21.8	22.2	22.6	22.9	23.3	23.7	24.0	24.4	24.8	25.2	25.5	25.9	26.2	63		
64	20.2	20.5	20.9	21.2	21.6	22.0	22.3	22.7	23.0	23.4	23.8	24.1	24.5	24.8	25.2	25.5	64		
65	19.6	20.0	20.3	20.7	21.0	21.4	21.7	22.1	22.4	22.8	23.1	23.5	23.8	24.2	24.5	24.8	65		
66	19.0	19.4	19.7	20.1	20.4	20.7	21.1	21.4	21.8	22.1	22.4	22.8	23.1	23.5	23.8	24.1	66		
67	18.5	18.8	19.1	19.5	19.8	20.1	20.5	20.8	21.1	21.5	21.8	22.1	22.4	22.8	23.1	23.4	67		
68	17.9	18.2	18.6	18.9	19.2	19.5	19.8	20.2	20.5	20.8	21.1	21.4	21.8	22.1	22.4	22.7	68		
69	17.4	17.7	18.0	18.3	18.6	18.9	19.2	19.5	19.8	20.2	20.5	20.8	21.1	21.4	21.7	22.0	69		
70	16.8	17.1	17.4	17.7	18.0	18.3	18.6	18.9	19.2	19.5	19.8	20.1	20.4	20.7	21.0	21.3	70		
71	16.2	16.5	16.8	17.1	17.4	17.7	18.0	18.3	18.6	18.9	19.1	19.4	19.7	20.0	20.3	20.6	71		
72	15.7	16.0	16.2	16.5	16.8	17.1	17.4	17.6	17.9	18.2	18.5	18.8	19.0	19.3	19.6	20.1	72		
73	15.1	15.4	15.7	15.9	16.2	16.5	16.7	17.0	17.3	17.6	17.8	18.1	18.4	18.6	18.9	19.2	73		
74	14.6	14.8	15.1	15.3	15.6	15.9	16.1	16.4	16.6	16.9	17.2	17.4	17.7	17.9	18.2	18.4	74		
75	14.0	14.3	14.5	14.8	15.0	15.3	15.5	15.8	16.0	16.3	16.5	16.8	17.0	17.3	17.5	17.8	75		

**115. Approximate Shrinkages of Various Wools.**—Preceding explanations have shown the reasons and conditions causing the wide range of shrinkages in various wools; and also account for different shrinkages from year to year in wools of the same grade and character from the same district. However, changes of the latter kind are never radical, and the average shrinkages for the various wools listed below afford a good relative comparison. It has been estimated that the average shrinkage of all United States wools is 55 per cent. The average shrinkage of our fine domestic fleeces has been estimated at 60 per cent. and the lower grade domestic wools average about 45 per cent. Fine territory wools average about 65 per cent. and the lower grades between 50 and 60 per cent. It is a well-known fact that territory wools, when shipped east, usually gain from 1 to 3 per cent. in weight, owing to the air near the seaboard being more humid. Some wools from river bottom lands in the Mississippi and Ohio Valleys lose weight on shipment to the seaboard.

The average shrinkage of foreign wools has been estimated as follows: Australia, 49 per cent.; South Africa, 58 per cent.; South America, 51 per cent. These estimates are made on the wool in bulk, and not on the net condition after skirting, which is the usual condition of these wools as they come on the market. Skirting reduces the total shrinkage from 5 to 20 per cent. It must be remembered that the "average shrinkage" here mentioned includes the total production with the variations in grade which accompany it. The wools of Great Britain and Europe are estimated to shrink at 25 per cent. and 34 per cent. respectively, but these wools are fleece washed, which reduces the shrinkage from 15 per cent. to 20 per cent. Fleece washing is seldom practiced in this country. It is accomplished by submerging the sheep previous to shearing in a tank of water. Foreign matter, such as dirt and sand, and suint are thus removed from the wool, but the yolk remains and must be scoured out.

#### 116. Approximate Shrinkages of United States Wools (Bulk).

DOMESTIC		TERRITORY	
Grade	Shrinkage	Grade	Shrinkage
Full blood and $\frac{3}{4}$ blood	60%	Fine and fine medium	67%
One-half blood	52%	Medium	62%
Three-eighths blood	46%	Three-eighths blood	54%
One-quarter blood	43%	One-quarter blood	48%
Common	38%	Common	43%

#### 117. Approximate Shrinkages of Choice Australian, South African, South American and New Zealand Skirted Wools (Net).

Grade	Geelong Riverina Port Phillip Victoria	Queensland Sydney New South Wales	West Aust, Adelaide South Australia	South America	Cape of Good Hope South Africa	New Zealand
66-74s (XX)	48%	50%	55%	58%	60%	55%
60-66s (X)	47%	49%	53%	56%	58%	52%
54-60s ( $\frac{1}{2}$ blood)	40%	40%	44%	48%	54%	40%
48-54s ( $\frac{3}{8}$ blood)	36%	37%	40%	40%	50%	35%
44-48s ( $\frac{1}{4}$ blood)	32%	34%	38%	38%	46%	30%
40-44s (low $\frac{1}{4}$ )	29%	31%	36%	35%	44%	26%
36-40s (common)	26%	28%	31%	32%	40%	23%

118. Approximate Shrinkages of Important British Fleece Washed Wools (Net).

Lincoln .....	20%	Shropshire .....	25%
Leicester .....	20%	Hampshire .....	30%
Cotswold .....	20%	Oxford .....	25%
Romney .....	20%	Dorset Horn .....	30%
Irish .....	18%	Cheviot .....	25%
Southdown .....	35%		

119. Shrinkage of Various United States Wools.—A good idea of the character of wool grown and average shrinkage in various States can be obtained from the following list:

	Shrinkage
Pennsylvania, West Virginia and Ohio, XX and X .....	56-62%
Indiana, $\frac{1}{4}$ and $\frac{3}{8}$ blood .....	38-43%
Illinois, $\frac{1}{4}$ and $\frac{3}{8}$ blood .....	45-47%
Missouri, $\frac{1}{4}$ and $\frac{3}{8}$ blood .....	43-45%
Northern California, medium and $\frac{3}{8}$ blood .....	55%
Southern California, fine and fine medium .....	72%
Texas Fall, fine and fine medium .....	58-64%
Texas Spring, fine and fine medium .....	64-72%
Idaho, medium and $\frac{3}{8}$ blood .....	50-56%
Wyoming, fine and fine medium .....	65-72%
Montana, fine and fine medium .....	63-69%
Montana, medium .....	57-60%
Arizona and New Mexico, fine to medium .....	60-73%
Washington, fine and fine medium .....	76-80%
Oregon Valley, braid to $\frac{1}{2}$ blood .....	40-55%
Oregon, Eastern, fine, fine medium and medium .....	60-70%
Kentucky, braid .....	35-40%
Virginia, braid .....	35-40%

## CHAPTER VI

### PULLED WOOLS

**120. Source of Supply.**—Pulled wool is obtained from the skins of slaughtered sheep. It is a by-product of the slaughtering and meat-packing industries. The large slaughtering houses also conduct the pulleries in most cases. In the United States the most important wool-pulling establishments are located in Chicago, St. Louis, New York City, St. Joseph, Mo., and Kansas City, and are conducted by such well-known meat packers as Swift & Co., Armour and Co., Morris & Co., Wilson & Co. and others. The four large firms mentioned slaughtered in their various main plants and branches a combined total estimated at about 7,963,590 sheep in 1923. There are about forty pulleries in this country, with an annual production ranging between 40,000,000 and 50,000,000 pounds. About 25 per cent. of the total pulled wools produced in the United States are eastern pulled.

Pulled wool is also known under numerous other names. The most common are skin wool, tanners' wool, glovers' wool and butchers' wool.

**121. Three Methods of Pulling.**—After the sheep have been slaughtered the skins are stripped from the bodies and the pelts are taken from the slaughter house to the wool-pulling establishment. When the wool has been removed from the skin, the latter is tanned and the leather is used for shoe linings, hat bands, book covers, roller leather and numerous novelties. The skin is more valuable than the wool, but before the skin is tanned it is necessary to remove all the wool. An exception to this is when the pelt is to be used for sheepskin coats, robes and rugs.

The three principal methods of pulling wool are the sweating, lime and depilatory processes.

**122. Sweating Process.**—The wool skins are hung on racks in a warm room with the atmosphere artificially moistened. The action of the heat and moisture on the skin loosens the roots of the wool so that it can be easily pulled out by the handful. Great care must be exercised when using this process, as the skins rot and decompose if left hanging too long. The sweating process is only slightly used in the United States. It is employed on inferior skin wools when the skin is of small value.

**123. The Industry at Mazamet.**—The most important center of the world's wool-pulling industry is Mazamet, a small city in the Department of Tarn, France. The sweating process is used at Mazamet, and the industry has been developed to a high point, employing over 2000 persons. The bulk of the fleeces is imported through the ports of Bordeaux and Marseilles. The establishment of the frozen-mutton industries of Australia and South America created increased quantities of wool skins, and caused pulled wool to become a considerable factor in the world's wool supply. There are a number of wool-pulling establishments in Australia and Argentina, but the bulk of the wool skins is shipped to Mazamet. In 1910 Mazamet received pelts which totaled 124,462,000 pounds. The source of origin follows: From the River Platte, 81,790,000 pounds; from Australia and New Zealand, 34,207,000 pounds; from South and North Africa, France, Spain and all others, 8,465,000 pounds. These figures represent the gross weight, which includes both skin and wool. The following quantities of pulled wool were shipped from Mazamet in 1910: 43,940,000 pounds of washed wool and 11,782,000 pounds of scoured wool. England purchases about 65 per cent. of the washed wool prepared at Mazamet.

Germany and Austria also prepare considerable pulled wool. German pulleries are unusually severe on the wool, which is usually from unimproved sheep and very inferior. The bulk of the sheepskins are purchased in Russia, Turkey, the Balkans, India and China. The lime process is used in Austria, and in addition to the domestic pelts the Austrian pulleries receive the bulk of



FIG. 71.—The Source of Pulled Wools, Sheep Slaughter House, Canterbury, New Zealand.  
*Reproduced by permission of The Philadelphia Commercial Museum*

the skins produced in Servia and Asia Minor. The Austrian pulled wools are superior in quality to the German skin wools.

**124. Lime Process.**—The wool skins coming from the slaughter house are thrown into tanks of water and allowed to soak overnight to remove suint, dirt and other foreign matter in the wool. The pelts are taken from the water tanks to scrubbing machines, which further cleanse the wool, but the natural grease remains untouched. This process is better known as brushing, and practically all pulled wools undergo it. The machine has a revolving steel cylinder placed over a lattice feeding apron. The cylinder has a spiral knife or edge with about a two-inch pitch covering its entire working surface similar to a screw thread. In front of the cylinder is a perforated water pipe, which operates under 90 pounds pressure and throws the cold water on the fleece side of the pelt as the apron carries it to the cylinder. The working edges of the cylinder are blunt, do not cut the wool, but give a scrubbing action, and are very effective in removing burrs. The next step is to remove any pieces of fat and flesh adhering to the pelts. The pelts are then ready for "painting," which is the most important operation in the process. The skins are turned with the flesh side up and are carefully painted with slack lime, which opens the skin pores and loosens the wool roots. The lime remains on the skins overnight. It is then cleaned off, and the skins are taken to the pulling room.

The lime process succeeded the sweating process and was the method employed in the United States and Australia until recent years, when it was largely superseded by the depilatory process. Pulled wools obtained by the lime process are also known as "slipe" wools.

**125. Depilatory Process.**—This process is the same as the lime process, with one exception. In the painting room, sodium sulphide, sulphuric acid and oyster shells form the compound, which is applied to the flesh side of the skins instead of lime,



FIG. 72.—Painting Room, Applying Depilatory to Flesh Side of Pelts.

and allowed to stand about ten hours. It is the most satisfactory process, causing the least damage to both wool and skin.

**126. Inferior Qualities of Pulled Wools.**—All pulled wools are inferior to fleece wools of equal grade and origin. They are especially deficient in spinning properties. The fibers do not adhere so closely, and will not take twist so readily as fleece wool. Yarns made from pulled wool are more open and loftier than yarn of even grade made from fleece wool. They are also harsh, brittle and lack elasticity compared with fleece wools. The characteristics of pulled wools can be expressed by the term "dead fiber" as compared with "live fibered" virgin wools.

Pulled wools are extremely hard to dye satisfactorily, due to the action of the painting preparation. This is especially true of wools prepared by the lime process, in which solid insoluble particles of lime stop up the medulla and the end pores of the cortical layer and the scale joints. This causes the fiber to resist impregnation by solutions. As a consequence the fibers do not absorb the dyestuff and unevenness results. Another factor which also adds to the above difficulty is the retention of the root, which is rounded off and closed by the hardening of the juices in the hair follicle. Neither end of the fiber in pulled wool is freshly cut, causing another difficulty in absorbing solutions.

**127. Grading and Sorting.**—When the wool skins reach the pulling room they are first graded according to the fineness and length of the wool. All kinds and breeds of sheep are slaughtered, and the pelts carry the widest range of wools imaginable. The length of fiber in pulled wools is governed principally by the length of time which has elapsed between shearing and slaughtering. The wools from the Merino breeds are classed as clothing, while the wools from the medium and long-wool breeds are long enough for combing after about six months' growth. Practically all the wools pulled from June to October inclusive are carding wools.

The pelts are ready for pulling and sorting after being graded. The puller throws the pelt on a table, fleece side up, and quickly



FIG. 73.—Pulling Room.

pulls the wool from the skin by the handful, throwing it into one of several baskets or barrels conveniently placed to receive the different sorts. When the receptacles are filled the wool is dried and taken to the storeroom, where it is dumped into bins. Each individual fleece loses its identity. No attempt is made to sort closely; only four grades are used, AA, A, B and C.

AA represents the XX and X in domestic grades and fine and fine medium in territory grades. A equals  $\frac{1}{2}$  blood domestic and medium territory. B corresponds to two grades in both domestic and territory—namely,  $\frac{3}{8}$  blood and  $\frac{1}{4}$  blood. C covers both common and braid in the other two classifications. Another system of grading pulled wools only uses three grades—fine, medium and coarse. Fine would correspond to  $\frac{1}{2}$  blood and above, medium would cover  $\frac{3}{8}$  and  $\frac{1}{4}$  blood, and coarse would represent common and braid.

The puller usually makes very few sorts from a skin. A fine fleece would be divided into AA, A, and the low parts would be thrown into B. A medium fleece would be given two sorts, B and C, while a coarse fleece would be thrown entirely into C. It must also be borne in mind that these wools are also sorted for clothing and combing staple.

The very short wool obtained from sheep sheared less than a month before slaughtering averages about one-fourth of an inch, and is known as "shearlings." This wool is used in the manufacture of hats and felts.

**128. Uses of Pulled Wool.**—While pulled wools are sorted as clothing and combing, a considerable quantity of the latter is spun on the woolen system for making strong, heavy warp yarns to be used in carpets and paper-mill felts. Pulled wools are used in medium and coarse fabrics, and large quantities are consumed by woolen mills featuring all-wool fabrics. They are also used in blends with wool substitutes and with cotton for making merino yarn. Pulled wools are especially adapted for use in soft-twist knitting yarns. Blanket mills use large quantities of the finer grades of pulled wool, and it makes a more attractive bed blanket

than virgin wool. The nap covers better, and the blanket has a lofty and spongy feel. There is a trifle less warmth in a blanket made of pulled wool than a similar blanket made of fleece wool. Yarns made with pulled wools are more open and loftier than those made from fleece wools. This is due to the inferior working properties, as the pulled wool fibers will not cling so closely together in drafting and twisting. When manufactured it is very difficult to distinguish between pulled and live wool.

Pulled wool is largely used in the manufacture of soft-twist knitting yarns, bed blankets, carpets and rugs, woven paper-mill felts, cheviots, cassimeres, flannels and dress goods.

**129. Marketing.**—Some of the large packing houses sell their pulled wool under their own name, while others have formed subsidiary companies to handle their wool. The wool merchant is not such an important factor in marketing pulled wool. While many of the wool merchants purchase pulled wools and sell them to the mills, the majority of the mills using pulled wools purchase directly from the pulling house.

The pulling houses scour large quantities of pulled wool, usually compressing it into bales resembling cotton bales, though smaller. Over half of our pulled wool is marketed in a scoured condition. The combing wools, however, are always sold in the grease, but of course the shrinkage is much less than the original shrinkage, due to the soaking in water and the brushing process. The price usually ranges from 10 per cent. to 20 per cent. less than similar fleece wool, depending on the market. Pulled wool amounts to 20 per cent. of the total wool produced in the United States. The average yearly production of this class of wool on a scoured basis is 30,000,000 pounds. Chicago is the most important producing city for pulled wools, and Boston and Philadelphia are the principal selling outlets.

**130. Shrinkages.**—The average shrinkage of pulled wools for this country is 27 per cent. It must be borne in mind that all pulled wools are washed in process, and the shrinkage which the

dealer and manufacturer has to consider is based on the wool in the washed state and not on its original condition in the fleece. Approximate shrinkages for United States pulled wools follow: AA, 35 per cent.; A, 25-33 per cent.; B, 12-20 per cent.; C, 15-25 per cent.

The actual shrinkage of pulled wools is greater than that of the same wool sheared. This is due to the fleece picking up considerable foreign matter, such as dust, manure, bedding, etc., while in transit to the slaughter house.

**131. Mazamet Pulled Wools.**—A list of Mazamet pulled wools with their description, quality and shrinkage follows:

	Quality	Shrinkage	Yield
Good fourths, long Buenos Aires .....	46s	10%	90%
Average fourths, long Buenos Aires .....	46s	15%	85%
Earthy fourths, long Buenos Aires .....	46s	28%	72%
Good fourths, 1/2 long Buenos Aires .....	46s	11%	89%
Average fourths, 1/2 long Buenos Aires .....	46s	15%	85%
Good thirds, long Buenos Aires .....	48-50s	14%	86%
Average thirds, long Buenos Aires .....	48-50s	18%	82%
Earthy thirds, long Buenos Aires .....	48-50s	28%	72%
Good thirds, 1/2 long Buenos Aires .....	48-50s	15%	85%
Average thirds, 1/2 long Buenos Aires .....	48-50s	18%	82%
Good seconds, long Buenos Aires .....	56s	17%	83%
Average seconds, long Buenos Aires .....	56s	22%	78%
Earthy seconds, long Buenos Aires .....	56s	34%	66%
Good firsts, long Buenos Aires .....	60-64s	28%	72%
Average firsts, long Buenos Aires .....	60-64s	30%	70%
Good fourths, long Montevideo .....	46s	14%	86%
Good thirds, long Montevideo .....	48-50s	18%	82%
Good seconds, long Montevideo .....	56s	22%	78%
Good firsts, long Montevideo .....	60-64s	36%	64%
Australian thirds, fourths, long super .....	46-50s	26%	74%
Australian seconds, long super .....	56s	22%	78%
Australian firsts, long super .....	64-70s	29%	71%

## CHAPTER VII

### MOHAIR AND OTHER TEXTILE HAIR FIBERS

**132. Distinction Between Hair and Wool.**—It is impossible to make a hard and fast distinction between hair and wool, as the coarser wools gradually blend to the structure and characteristics of hair. As fiber approaches hair the serrations become fewer, the diameter increases, the felting property decreases and the luster becomes greater. Hair, strictly speaking, is straight, non-elastic and glossy; stronger, smoother and usually coarser than wool, and is totally deficient in felting properties. In hairs the medulla or core is often more prominent than the surrounding cortical layer of fibrous cells. The epidermal scales are absent, except in cashmere, vicuna, mohair and alpaca, which possess thin, flat scales of comparatively large area. Cashmere and vicuna and the best grades of mohair and alpaca do not show any medulla, and more closely approach wool than any other hair fibers.

**133. Mohair.**—Mohair is the name given the hair grown by the Angora goat. The word "mohair" is derived from the French "mohere," and primarily from the Arabic "mukhayyar," meaning mohair cloth. The Angora goat is a native of Asia Minor, and takes its name from the district of Angora, which is the center of the industry. The Turks have raised Angora goats for over 2000 years. The original Angora type has been changed, due to the Turks crossing the pure-bred flocks with the common "Kurd" goats. This resulted in so great an infusion of inferior blood that no "pure-blood" Angoras remain. This crossing has coarsened the hair, and two distinct types of hair are now produced even on the best Angoras—namely, the soft wool-hair and the undesirable stiff beard-hair. Mohair is featured by its strength and high luster.

**134. Sources of Supply.**—The three principal mohair-producing countries are South Africa, Turkey and the United States. Russia and France produce mohair to some extent, but the quantities are small compared with the former countries. The annual clips are estimated for South Africa at 25,000,000 to 30,000,000 pounds; Turkey, 12,000,000 to 15,000,000 pounds, and the United States, 6,000,000 to 8,000,000. Turkish mohair is superior to the others. The flocks of South Africa and the United States were established by importations direct from Turkey, but no more Angoras can be obtained, as the Turkish Government passed an embargo prohibiting their exportation, attempting to gain a monopoly of the mohair industry. Our country also places very severe restrictions on the importation of any class of live stock from Asiatic countries as a safeguard against contagious diseases. Turkey was too late in her prohibitive measures, as enough good breeding stock had been secured to firmly establish the Angora flocks in South Africa and this country. Within the last few years the flocks have been considerably increased in this country, and additional breeding stock was brought from South Africa. The South African Government, to prevent the decline of its mohair industry through the loss of the best breeding stock, prohibited the further exportation of Angora goats.

In both South Africa and the United States the Angoras are mostly crossed with native goats. In this country the mohair industry is confined to Texas, New Mexico, Arizona and to a smaller extent in California and Oregon.

**135. Type Description of Angora Goat.**—Modern Angora goats are bred for size and strength of constitution, but a tendency to coarseness must be avoided, as such animals will not produce the finest fleeces. The Angora is smaller than the ordinary goat. The terms used to distinguish the various members of the goat family follow: The buck is a male used for breeding. A wether is a castrated male, a doe is a female goat, and a kid is the young offspring. Bucks are heavier than wethers, which in turn are heavier than does. From 60 to 80 pounds is the range for bucks.

The average weight of Angora goats in the United States is 60 pounds.

The chest should be broad and deep, indicating a strong constitution; the body round, and the legs short and strong. The head should be upright and clean cut, with a bright eye and a broad muzzle. The horns of the male turn upward and outward with a backward twist, and have an average length of 18 to 20 inches, while the horns of the doe are about one-half the length,



FIG. 74.—Angora Buck and Doe.

turning upward and backward, with only a slight inclination to twist. The back should be straight and the shoulders of equal height. A sloping rump must be avoided.

The color of the fleece should be a shining, silky white. Dark-colored fibers depreciate the value, and while nearly all fleeces contain some kemp (chalk-white dead fibers without luster), it is always objectionable, and the smaller the amount present, the better. Kemp is always coarser than the rest of the fleece. Mohair has even a greater affinity for dyes than wool.

**136. Caring for Goats on the Range.**—In general, the goats are handled much the same as the sheep, save that the constant presence of the herder is not necessary. Many goatherders turn the animals out of the pens in the early morning, sending a dog with them to keep away wild animals. During the day the herder rides out to the herd once or twice to note the direction in which they are feeding. Usually if they are allowed to graze alone the goats will travel too fast and cover too much country, which is injurious to the range as well as the animals. Careful herders remain with their goats and check this tendency to travel.

The necessary equipment for raising goats is somewhat similar to that for sheep raising. It is especially necessary that proper sheds should be furnished to shelter the goats during wet weather, as they are very susceptible to moisture. Contrary to the general belief, no domestic animal is more fastidious as to its food than the Angora. When fed hay or other artificial food every care must be taken to keep the food away from the mud and dirt; Angoras will refuse to touch any food which is soiled or trampled in the ground. Muddy or foul drinking water will not answer, and fresh water must be furnished if these animals are to do well either on the range or in feed lots.

Angoras will always endeavor to find shelter from approaching storm, and must have sheds under which to creep during stormy weather. As long as it is clear and cold, or the snow is dry, they are comfortable and remain out; but their long, open fleece is soon soaked in the rain, and is seriously affected by the moisture on their bodies.

Angoras require plenty of air and light, and all sheds provided must be open as much as is compatible with keeping out rain or snow. The pens should never become muddy, for the long, silky fleece will easily pick up a great weight of mud, which not only burdens the animal but stains and injures the fleece as well.

Contrary to the general idea, the raising of Angora goats is rather difficult. The young are more delicate than lambs, and their mortality is greater, especially among the well-bred animals.

Incessant personal care is absolutely necessary in raising the kids until they are about two months old. The methods of raising the kids are many, especially during their early weeks, when it is inadvisable to let them follow the doe out upon the ranges.

The browsing habit of the goats renders them available even on land where other domestic animals would not find sufficient feed. Goats relish and thrive on all manner of browses; on leaves, shrubs and small trees, and on moderate amounts of weeds and grass. Despite the general opinion, goats will not do well on brush alone, although a large part of their food is browse. Because of their liking for browsing, goats are occasionally introduced into many States solely for the purpose of clearing the land of brush and bringing it into pasturage. This same browsing habit has caused their exclusion from many parts of the national forests throughout the West, and from watersheds where it is desirable to protect the brushy cover in order to prevent erosion and the filling up by silt of the reservoirs for water supply.

The land upon which goats thrive best being generally useless for other domestic animals, its actual or rental value is much below that of pasture land for cattle or sheep, although on the various national forests practically the same fees are charged for goats as for sheep. The total average yearly cost for grazing for one goat is about the same as that for one sheep in the same region, or sometimes a little less. This statement refers, of course, to range-raised goats and not to those raised in small flocks upon farms or within small pastures.

**137. Shearing and Preparing Mohair.**—Goats do not take kindly to shearing and are much harder to handle than sheep. Various methods are used to aid the shearer. One of the best is a specially built table with collapsible sides, forming a trough. The goat is placed in the trough on its feet and a strap passed around the goat's neck and fastened to each side of the table. The legs and belly are then shorn. The legs of the goat are next tied together, the strap removed from the neck; the sides of the table lowered and fastened level with the centerpiece. The goat is laid



FIG. 75.—Shearing Angora Goats.  
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on the top of the table and the shearing is completed. Both machine and hand shearing are used.

In Turkey the goats are shorn only once a year, but in South Africa shearing is usually necessary twice a year. In the United States, the goats are shorn twice a year, except in Oregon and Northern California. Warm climates usually compel shearing twice a year, on account of the tendency of the hair to come out. Shearing should take place before the goat starts to shed, as the fiber loses its life and luster during shedding. The time of shearing depends on the weather and the condition of the fleece. If the shearing is done too early the goats may suffer from the cold.

The spring shearing in the Southwest takes place in March or April, and the fall shearing in September or October. The cost of shearing varies from 10 to 15 cents per head. The average weight of American Angora fleeces is about 2.25 pounds.\* The average for Turkish Angoras is 2.75 pounds per head, while the fleeces of South Africa average 3.5 pounds.

The fleeces from the kids, wethers, does and bucks should be packed in separate bags, as they represent different grades. Stained locks and tags should also be in a separate bag. After shearing, the fleeces are compactly rolled with the cut side out, and should not be tied. The presence of sisal or similar string frequently used in tying the fleeces will often reduce the price of mohair 25 per cent., as the fibers from the string often become mixed with the hair, and are carried through the various manufacturing processes, causing a defective finished product.

The grower receives a better price for his clip when it reaches the market in a good, presentable condition, as less time and labor are required to prepare it for manufacturing than is the case with mixed and poorly prepared clips.

**138. Grading and Sorting.**—The mohair fleeces are usually graded at the mill. The principal factors determining the various mill grades are length of staple, luster, amount of kemp present

\* In 1919 this average had increased to 3.5 pounds, and in 1923 to 4.2 pounds.

and fineness of fiber. Fineness determines the grade when considering wool, but this property is of less importance with mohair, which is seldom spun to very fine numbers. The degree of luster is very important. The length largely determines the value. The staple fabrics made from mohair require combed yarns. Six inches and over are required for combed mohair yarns; the shorter fibers are spun on the woolen system. Much of the mohair produced in the Southwest is short. High-grade flocks in Oregon and northern California, where the goats are only sheared once a year, produce hair averaging from 10 to 15 inches, but coarser than Texas hair. Our domestic mohair averages from four to ten inches in length. Every effort is made to grow as long a staple as possible. Foreign mohair usually runs from 9 to 12 inches in length.

As a rule, the finer mohair is shorter stapled. The influence of breed, climate, soil and care is as great in determining the character of hair produced as the same factors with the wool of sheep. Domestic mohair contains about 15 per cent. more kemp than the foreign, but by better breeding this difference is being gradually reduced. Young Angoras produce the best quality of mohair; kids, yearlings, and does are preferred in the order named. As the goat grows older, the hair becomes coarser, thinner and straighter. To produce the finest grade of mohair, the flocks must be kept young and active.

First-class foreign mohair will spin to 60s Bradford system, while our first-class domestic mohair will only spin to 40s. Domestic mohair ranges from 15 to 25 per cent. shrinkage. The shrinkage varies with the quality and section grown. The finer grades shrink heavier than the coarser qualities. Mohair produced in the Southwest shrinks more than that grown in the Northwest. Foreign mohair averages 14 per cent. shrinkage.

Sorting is performed on mohair fleeces in the same manner as wool, only less attention is paid to small differences in fineness. The sorts are made according to length, luster and kemp. No



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FIG. 76.—Alpaca.

generally accepted grades are used in stating the quality of mohair. Some of the methods follow:

Fine combing or carding. Best combing or carding. First combing or carding.  
Medium comb. or carding. Good combing or carding. Second comb. or carding.  
Coarse comb. or carding. Ordinary comb. or carding. Third comb. or carding.

**139. Market Quotations for Mohair.**—A typical market report on domestic and foreign mohair will be found in the appendix.

**140. Marketing Mohair.**—Our domestic production only supplies about two-thirds of the total mohair consumed in manufacturing in this country. The domestic mohair is usually sold by the grower, individually or through growers' association selling agencies, direct to the mills. Occasionally wool merchants in Boston and Philadelphia receive a clip on consignment, or sell to the mills from samples furnished by the grower. When sales are made by the latter method the grower usually ships the mohair direct to the purchaser. The selling commission usually charged is  $\frac{1}{2}$  cent per pound.

Most of the foreign mohair entering this country is imported by wool merchants in Boston, Philadelphia and New York.

**141. Uses of Mohair.**—Fabrics made from mohair are remarkable for their durability and brilliancy. Staple goods manufactured from mohair include pluses, coat linings and lap robes. Changes in fashion influence the demand for mohair, and some seasons when mohair dress goods, summer suitings, bathing suits, braids, henrietas, zibilines, astrakhans and other novelty cloakings using mohair, imitation furs, etc., are in style, the demand usually exceeds the capacity of the mills spinning this fiber. The best mohair pluses are almost indestructible, and are used by railroads as the most durable of seat coverings.

Bradford, England, is the largest mohair manufacturing center, and exports mohair fabrics in large quantities to the Continent and the British colonies.

Kansas City is the only important goat market in the United States. The skins, tanned with the hair on, are extensively used for carriage robes, muffs and trimmings for coats and capes.

**142. Alpaca.**—This fiber is obtained from the alpaca, and the bulk of it represents a growth of two years with the fleeces averaging five pounds. At times, when they are hard pressed for money, the Indians shear their alpacas before the fleece has attained a good length, but only receive a small return, as such stock is undesirable and cannot be processed on the worsted system. The alpaca fiber closely resembles the better grades of mohair, and is sometimes blended with them. It is softer, finer and less lustrous than mohair. The length varies from 10 to 16 inches. The shrinkage is from 15 to 20 per cent. Contrary to the custom in wool, reddish brown and not white is the most valuable color in alpaca. The color varies from white, through brown, to black. Alpaca is required in certain dress goods fabrics and high-grade coat linings.

**143. Vicuna.**—Vicuna is produced by the animal of that name. It is an exceedingly fine, delicate and soft fiber, somewhat resembling alpaca, but much shorter and softer. It is spun on the woolen system, the length averaging between two and three inches. The color is usually reddish brown. Vicuna is required in bona fide montagnac overcoatings, and is sometimes present in very fine underwear.

**144. Llama.**—This fiber also receives its name from the animal producing it. It is usually brown. Llama is inferior to alpaca, being coarser and shorter.

**145. Summary on Alpaca, Vicuna and Llama.**—The animals producing these fibers are peculiar to the Andes in the southern part of Peru and adjoining territory in Bolivia. They are all of the same general species, being closely related to one another, and are best described as small, goat-like camels. The alpaca and llama have been domesticated. The llama is used as a burden-carrying animal, but is being supplanted by burros, and is gradually disappearing. The alpaca thrives in a restricted territory, not lower than 5000 feet. The estimated number of alpacas in Peru is 1,000,000.



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FIG. 77.—Llamas, San Mateo, Peru.

The vicuna is found in the same regions as the alpaca, but usually at a higher elevation. These animals are wild, and run in herds near the regions of perpetual snow. They resist all attempts at domestication, and unfortunately are fast becoming extinct, as the fleece is only obtained after the animal is shot. The killing of vicunas is now prohibited by law. The small quantity of vicuna now exported is supposed to come from animals which have met a natural or accidental death. Vicuna brings \$2.50 and \$3.00 per pound, and is seldom seen in the United States. The small quantity now available is exported to France. The exportation of live alpacas and vicunas has been prohibited by Peru, as they invariably die when removed from their native haunts.

These three fibers possess the same general characteristics, varying in length, softness, fineness and luster. As with the Angora goat, two classes of hair are present in every fleece, the stiff beard-hair and the soft wool-hair.

Arequipa, the principal city in southern Peru, is the market for the entire production of these fibers. The seaport for Arequipa is Mollendo. On receipt at the warehouses in Arequipa the stock is first washed and then sorted. The alpaca is sorted into five qualities by Indian women. The grades are fine, coarse, pulled, shorts and pieces or locks. The first two qualities are then sorted into five grades according to color. Almost the total production of alpaca and vicuna is exported, but a large portion of the llama is consumed by Peruvian mills and Indian manufactures. The following represent average annual exportations: alpaca, 5,000,000 pounds; llama, 2,000,000 pounds, and vicuna, 3000 pounds. The alpaca is usually distributed as follows: Great Britain, one-half; France, one-third, and the United States, one-fifth.

**146. Cashmere.**—This fiber is obtained from the native Cashmere and Thibet goats which are found in the Himalayan Mountains of Asia. The principal districts for cashmere are the provinces of Cashmere in northern India and Thibet in southwestern

China. Cashmere is grayish in color and is noted for its soft, silky qualities. The goats grow two qualities of fiber; the outer fibers are long, coarser beard-hairs,  $3\frac{1}{2}$  to  $4\frac{1}{2}$  inches long, and the under coat is of fine, soft down-hairs, 1 to  $3\frac{1}{2}$  inches long. In making the finest fabrics, the long beard-hairs must be sorted out. The down-hair is used in making the famous Cashmere and Indian shawls. It is usually spun on the woolen system. The Cashmere goats are not sheared, the hair is obtained when the goats shed their fleeces in the spring, or it is removed by combing. Each fleece only weighs about half of a pound. The production is manufactured in India. In working properties, cashmere more closely resembles wool than any other textile fiber.

**147. Bombay Hair.**—This fiber is similar, but inferior, to cashmere, and is produced in India. Bombay hair is shipped to England and is used in dress goods and knit goods.

**148. Camel Hair.**—The principal sources of supply are Russia and China. The former annually exports about 8,000,000 pounds and China about 3,000,000 pounds. Great Britain is the largest consumer, taking 6,000,000 pounds, and the United States follows with 4,000,000 pounds, nearly all of which is shipped via Liverpool.

All Asiatic camels are of the same race, but climatic conditions and the care and treatment given the animals have their effect on the quality of the hair. In the hot southern countries the hair is shorter, stubbier and of little use. In Northern and Central Asia the milder climate gives longer, sounder and finer hair.

Most of the camel hair used in this country originates in the Russian steppes between the Volga and Ural Rivers and bordering on the Caspian Sea. It is collected, packed and shipped to England or this country from several large cities in that section, or is sent up the Volga River and sold at the big annual fair at Nijni Novgorod in August and September.

Considerable short-stapled camel hair is also produced in Asia Minor, Arabia and Northern Africa, but is mostly consumed in



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FIG. 78.—Group of Camels in the Nan Kov Pass, Great Wall, China.

local manufactures, and is seldom exported. Very little short-stapled fiber, such as the Central Asia kinds, is used in this country.

Camel hair is shipped without any preparation other than a rough sorting for grade. The shrinkage usually falls between 25 and 35 per cent.

The fiber is remarkable for its great strength and softness. The camel, like the Angora goat and similar hair-producing animals, produces two kinds of hair. The fine, soft wool-hair varies in color from yellow to brown and the average length is about  $2\frac{1}{2}$  inches. The coarser and stiffer beard-hair ranges in color from dark brown to black, and the length varies from 4 to 12 inches. The hair of young camels is free from beard-hair and is extremely fine and soft. The bellies of older camels are also free from beard-hair, and such hair is kept separate.

Camel hair is worked on the worsted and woolen principles, but the latter is the most common method. The principal use of camel hair in this country is the manufacture of press cloth for use in cottonseed and linseed oil compresses. This material requires a yarn of the greatest possible tensile strength, and is obtained by using the long, strong beard-hair. The fiber is slippery, lacks spinning properties and shows a slight luster. It is used in its natural condition or dyed to dark shades, and cannot be bleached. When used in making novelty napped cloakings, robes and dress goods, knitted fabrics, blankets and rugs, soft, short camel hair is usually blended with wool or cotton. It is imported and marketed by wool merchants, the price ranging from 11 to 18 cents per pound, according to the grade and market.

**149. Horse Hair.**—This fiber is obtained from the tails and manes of horses. It varies in length from 8 inches to 3 feet. The color varies, but black is most common. The individual hairs are cut to suit the desired fabric width, and are extensively used as the filling with a cotton warp in manufacturing hair cloth. Hair cloth is used as a shape-retaining foundation in

tailoring coats. Horse hair is also used as a superior stuffing material in the upholstering trade.

**150. Cattle Hair.**—This is obtained from the bodies of dead cows and horses. It is freed from the hide by a pulling process. The color varies and is desired in the following order: White, black and brown. The length varies from  $\frac{1}{2}$  inch to 2 inches. It cannot be spun alone, but is blended with low-grade wool wastes and reclaimed wool stock or cotton in coarse yarns worked on the woolen principle for low-grade rugs, carpets, horse blankets and the poorest grades of tweeds. It is also blended with cotton and reclaimed wool stock in the manufacture of felts. The collapse of the ingrain carpet industry has removed one of the principal outlets for cattle hair. The value is determined by color, softness and length.

**151. Goat Hair.**—This includes the hair grown on common goats. The properties and uses are identical with cattle hair.

## CHAPTER VIII

### REWORKED WOOL AND WASTE PRODUCTS

**152. Importance and Necessity.**—The general public loosely applies the term "shoddy" to cover all such materials, but this is a misnomer. The demand for cheap grades of wearing apparel and the insufficient production of wool compel the use of reworked wool and waste products. The world's annual production of wool is many millions of pounds short of the demand. The exclusion of reclaimed fibers as a raw material would impose a hardship on a large proportion of the inhabitants of the temperate zone, as clothing made from pure fleece wool would be too expensive. In nearly all instances, reworked wool is used for the purpose of producing fabrics at a low price.

These various materials comprise about one-third of the total raw material for our woolen industry. The following estimates for 1923 show the importance of these raw materials to the woolen industry of the United States; noils, 33,000,000 pounds, valued at \$17,000,000; wastes, 30,000,000 pounds, valued at \$5,000,000 (worsted thread waste amounts to 80 per cent. of this), and reclaimed fiber from rags, 85,000,000 pounds, valued at \$12,000,000. The quantity of reclaimed fiber includes about 30,000,000 pounds produced from rags by woolen mills for their own use.

These various substitutes are seldom used alone, but are blended with fleece wool, pulled wool or cotton. Fleece wool and pulled wool are used to improve the quality, strength and spinning properties of the blend. In some of the lowest grades of manipulated fabrics the cotton costs more per pound than the reworked wool materials used.

The process of reclaiming wool from rags was invented in England about 1815, but was not used to any extent in this

country until about 1850 with the development of the factory system and the disappearance of household manufacturing. The demand for worsted cloth in recent years has prevented any expansion of the "shoddy" industry in this country since 1889. There are about ninety establishments in the United States, nearly all of which are located in the East, where the carded-woolen mills are most numerous. In addition to these, nearly every woolen mill manufactures for its own use a considerable quantity of reclaimed fiber from purchased rags and the various wastes made by the mill. The total number of rag machines in this country is about 350.

The cities of Batley and Dewsbury, located in the Colne Valley, Yorkshire, England, are the center of the world's greatest "shoddy" producing district. This district contains about 900 machines, and is noted for the great skill shown in manipulating low-grade stock to produce finished fabrics of excellent appearance.

#### ECONOMIC ASPECT OF SHODDY

**153. Economic Aspect of Shoddy.**—Of late there has been considerable agitation for so-called "Truth in Fabric" legislation, the object of which has been supposedly to protect the consuming public from fraud, by causing manufacturers of woolen fabrics to label, distinctively and properly, their product, indicating what per cent. of the whole is reworked fiber or "shoddy." Attempts to pass such legislation have, through wide publicity, tended to instill in the minds of the general public that all shoddy is a material of imperfect fiber and of low quality, and that its use should not be permitted.

On the contrary, a good deal can be said of shoddy and its discriminating use in the manufacture of woolen goods.

As it is generally conceded that approximately one-third of the raw material manufactured into woolen fabrics at the present day consists of reworked fiber, the question becomes a large and comprehensive one. The aversion towards this class of material is in general unwarranted. The prejudice against shoddy is

principally due to a misunderstanding of what it really is, and to what extent it has to do with making up the deficiency of the world's supply of wool and thereby making it possible to supply cheap woolen goods for those who otherwise would not be able to wear woolen goods at all. Irrespective whether the wool in a woolen fabric is fleece wool or reworked wool, the question narrows itself down to one of fiber, and should be discussed, and judgment based, and comparisons made, not on origin alone, but on the quality of the fiber entering into the makeup of the fabric itself. It has already been pointed out, in the consideration of wool, that the fleece of the sheep consists of widely varying qualities of fiber, some of them being tender and of low grade, imperfect in structure, coarse, short and of poor quality. There is, in fact, a great deal of high-grade reworked wool produced, which is a far superior grade of material for woolen manufacturing purposes than is often found to be the case in some fleece wools. A law which compels the labeling of fabrics according to the origin of the raw material rather than to the quality of the fiber used, would work a great injustice to the masses, for under such circumstances fabrics could be made from imperfect, poor-quality fleece wool and yet be classed as having been made from "pure fiber fleece wool," and therefore serve all the requirements of the law's demand, while, on the other hand, fabrics made from a better class of fleece wool and containing more or less good reworked wool or shoddy, would have to be branded and therefore discredited in the eyes of the purchasing public, notwithstanding the fact that these latter fabrics, made from a combination of good fleece wool and shoddy, may possess a far better appearance as well as handle and serve the consumers' demand from every viewpoint; nevertheless, they would be considered inferior and undesired. After all, the wearing qualities and other characteristics of a fabric do not depend so much on whether it is made from fleece wool or reworked wool, but on whether it is made from high-grade or low-grade fiber. To the unbiased, the manufacture of shoddy is a very useful and legitimate indus-

try, as it utilizes a by-product which otherwise would have to be wasted. That the use of shoddy, on the other hand, is abused, and that it is introduced into goods that are misrepresented as being of higher quality than they really are, there is no doubt, but this is also a tendency in many other lines of manufacture other than those of the woolen trade.

#### CLASSIFICATION OF REWORKED WOOL

**154. Classification of Reworked Wool.**—Unlike fleece wool, tops, yarns, etc., no “clear cut” classification can be made of reworked or recovered wool.

Reclaimed fiber products are as numerous as the combinations which may be made from the by-product or rag, with their ever-varying color combination, structure and condition considered. However, obviously, all recovered wools may be divided into two general classes. (a) The fiber resulting from the wastes made in manufacturing processes, and known as soft material, not having been previously made into woven or knitted textures, and (b) the fiber resulting from cast-off clothing and worn-out domestic fabrics described as rags, in which are included tailors' clippings, remnants and bits of new cloth, shawls, sweaters, stockings, soft material, dress goods, etc.

For technical and commercial purposes, the following classification is the one generally adopted:

Noils .....	Rejected fibers, in combing process.
Soft wastes...	Slubbing, roving, etc., made during processing.
Hard wastes..	Yarn and thread waste spinning, warping and weaving waste.
Shoddy .....	Soft woolens and worsteds, unfulled.
Mungo .....	Hard, woven and felted cloths.
Extract .....	Union fabrics (cotton and wool).
Flocks .....	From fulling, gigging and shearing operations.

**155. Noils.**—Worsted combing separates the wool according to staple length, the comb being set to remove fibers under a desired length. The combed product, consisting of the longer and straightened fibers, is called “Top” and is used in the making of worsted yarn. The short, wavy, undergrowth fibers extracted by the comb are known as “Noils” and are a waste product of



FIG. 79.—Worsted Products.

1. Top	4. Worsted Yarn
2. Slubbing	5. Noils
3. Worsted Roving	6. Carbonized Noils

the worsted industry, but make an excellent raw material for the woolen industry. Noils are used to good advantage in fabrics requiring a napped face. They are used extensively in knitting yarns, blankets, flannels and broadcloths. In addition to wool noils, mohair, camel hair and alpaca, when spun on the Bradford system, furnish mohair, camel hair and alpaca noils.

The wool noils are divided into long-wool noils and short- or fine-wool noils. The former are obtained from such long wools as Lincoln, Cotswold, Leicester, Romney, etc. The fine-wool noils are obtained from medium and fine Australian, Cape, Continental, South American and domestic wools. The term "domestic" when applied to noils includes noils obtained from all wools grown in this country, and no distinction is implied between noils from territory and domestic wools. The term is frequently used in a similar manner to distinguish wools produced in this country from foreign wools.

The noils are the same grade or quality as the tops. They are classified according to the grade of wool from which they were combed, as fine domestic noils,  $\frac{1}{2}$  blood domestic noils,  $\frac{3}{8}$  blood domestic noils,  $\frac{1}{4}$  blood domestic noils, coarse domestic noils. In the United States, foreign wool noils are usually classified in the same manner, as fine Australian noils,  $\frac{1}{2}$  blood Cape noils,  $\frac{3}{8}$  blood South American noils, etc. In Great Britain and the Continent, tops are classified by the yarn count to which they are supposed to spin, and noils are classified on the basis of the quality of the top produced by combing. A 40s noil is one secured by the production of a 40s top. The percentage of noil taken from wool depends upon the relative amount of short fibers present in the wool and the setting of the comb. Fine wools produce a higher percentage of noil than coarse wools. The percentage of noil removed by the comb usually falls between 7 and 25 per cent., depending on the above conditions. Average percentages for different grades of domestic combing wools are: Fine, 17 per cent.;  $\frac{1}{2}$  blood, 15 per cent.;  $\frac{3}{8}$  blood, 12 per cent., and  $\frac{1}{4}$  blood, 10 per cent.

Just previous to combing, the sliver has usually been treated with an emulsion to improve the working properties of the wool. In such cases the amount of emulsion present in the noils removed from the sliver is usually about 3 per cent. of the gross weight of the noils.

**156. Carbonized Noils.**—All wools contain varying amounts of vegetable matter in the form of bits of straw, chaff, burrs, etc. Combing extracts the bulk of this vegetable matter which is removed with the noils. The removal of this vegetable matter is usually necessary to make the noils suitable for use. It is accomplished by carbonizing the noils—*i. e.*, subjecting them to a sulphuric acid bath, which reduces the vegetable matter to carbon and leaves the wool noil practically unharmed. The absence of foreign matter also improves the spinning properties of the noil. Noils vary in length from  $\frac{1}{2}$  inch to 2 inches; the length usually secured is between  $\frac{1}{2}$  inch and 1 inch.

In order to obtain satisfactory results in the dyeing of carbonized noils, it is good practice to use top chrome, whereas meta chrome can be used on uncarbonized noil for same shade. All Australian noils require carbonizing.

Firms devote their entire attention to buying noils from worsted mills, grading and carbonizing them, and selling them to woolen mills. The noil dealers frequently contract with worsted mills to purchase their entire annual production of noils at a stipulated price. Other worsted mills prefer to allow their noils to accumulate, and await favorable market conditions in order to dispose of them at an advantageous price. Numerous wool merchants and "shoddy" dealers also deal in noils, frequently handling them for the worsted mills on a commission basis.

**157. Second Combing Noils.**—In the manufacture of fine counts, spinners frequently recomb the top to remove any noil which has escaped the first combing. The percentage of noil thus secured seldom exceeds 5 per cent., and such noils are more valuable than first combing noils, as they are free from vegetable matter and do not require carbonizing.

**158. Noil Market Quotations.**—A typical market report for noils is included in the appendix, on page 232.

**159. Soft Wastes.**—In the various gilling and drawing processes of worsted manufacture previous to the actual spinning process, sliver, top, slubbing and roving wastes are produced. The term "waste" as applied to these materials is misleading, as they have suffered no loss in value. Very little of this waste is offered for sale, as the worsted mills work it up in a new lot entailing no loss to the mill except the small expense of handling it twice. Soft wastes sell for approximately the same price as scoured wool of equal quality.

Similar soft waste, such as sliver and slubbing waste, produced on the woolen system are reserved for inclusion in later identical lots. However, such soft wastes as card stripings, card fly and floor sweepings are subjected to treatment by a waste-dusting machine, and if unsuited for blending in lots intended for lower grade fabrics made by the mill they are sold to dealers.

**160. Market Quotations for Soft Wastes.**—Quality descriptions and a list of comparative prices will be found in the appendix, on page 232.

**161. Hard Wastes.**—These are also known as yarn waste, thread waste and garnetted hard ends. Worsted and woolen mills unavoidably make a considerable quantity of yarn waste. The most prominent sources are the spinning room, spooling, winding, warp dressing and weaving. The yarn wastes are kept separate in bags or bins according to their quality and color. For example, a worsted mill is spinning yarns from  $\frac{1}{2}$  blood,  $\frac{3}{8}$  blood and  $\frac{1}{4}$  blood wools. The yarn waste from each of these grades would be kept separate. A woolen mill would not mix its all-wool white yarn waste with a merino white yarn waste, or a mixture with a solid color, even of the same quality, unless the stock was to be dyed later to a darker shade.

The method of recovering the fiber from hard waste is simple. The yarn waste is usually fed by hand on a feeding apron to

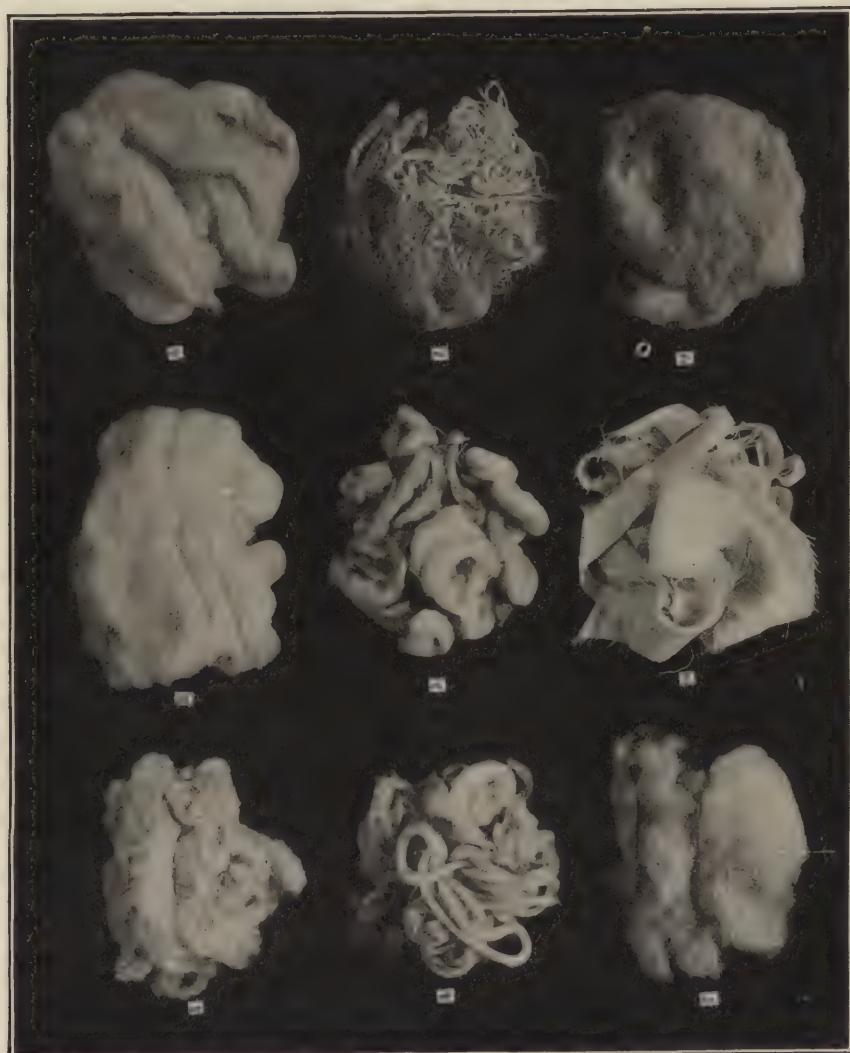


FIG. 80.—Wool in Various Forms.

1. Scoured Wool.	6. Worsted Thread Waste.
2. Top Waste.	7. Garneted Worsted Thread Waste.
3. Slubbing Waste.	8. New White Serge Clippings.
4. Worsted Roving Waste.	9. Shoddy Made from Old White Sweaters.
5. Ring Waste.	

the garnett machine, which tears the thread apart and delivers the wool fibers upon a burlap sheet, which is spread on the floor at the front of the machine. The garnett machine is constructed on the same general principles as the woolen card. The working parts, however, are covered with metallic teeth instead of wire card clothing. Garnett machines are built with 1, 2, 3, 4 or 5 cylinders. Each cylinder requires a doffer, and when 2 or 3 cylinders are used the back doffers transfer the stock to the cylinder in front. After leaving the garnett machine the stock is frequently run through a breaker card to still further separate the fibers and improve the working properties. Extra hard twisted yarn and heavy feeding frequently cause inferior results on the garnett machine, delivering threads in the same conditions as fed. Garnetted stock containing numerous threads intact must be treated a second time by the garnett machine.

The garnetting process is naturally severe on the fibers, and a large percentage is broken, making the staple length of the garnetted stock considerably shorter than the wool in the yarn from which the stock was obtained. Yarn waste is the most useful of the recovered fibers. The fiber recovered from worsted yarns makes a superior raw material for woolens, possessing good length, strength, spinning and felting properties. Garnetted worsted hard ends are always superior to the best grades of fibers reclaimed from rags. Woolen yarn waste is usually garnetted and consumed in the mill where it originated.

Hard wastes are usually graded for fineness and color, as fine white or colored, medium white or colored and low white or colored. The quality is sometimes designated by the grade of wool used as  $\frac{1}{2}$  blood white thread waste,  $\frac{1}{4}$  blood colored thread waste, etc.

The hard wastes are purchased from the mills by the "shoddy" manufacturers, who process them and then sell them to the woolen mills. Some woolen mills purchase the hard waste direct from the worsted mills and then garnett it at the mill.

**162. Market Quotations for Garnetted Yarn Waste.**—A typical list showing usual descriptions and comparative prices is included in the appendix, on page 233.

**163. Shoddy.**—The term "shoddy" used specifically is wool reclaimed from soft woolen goods, such as stockings, sweaters and soft merino dress goods. All wool fiber reclaimed from rags is called "renaissance wool" by the French, meaning wool fiber reborn or reclaimed from rags. Shoddy is superior in strength and working properties to similar raw materials obtained from rags.

The manufacture of shoddy consists of a number of processes. Sorting is usually performed by the rag dealer, who knows the requirements of the so-called "shoddy" manufacturer. Care must be exercised in sorting in making the different shades and qualities in order to produce a uniform product. The rags are dusted in a waste duster or willow. This machine consists of a cylinder covered with long spikes all caged in, with a grating underneath the cylinder to allow the dust to pass through to a compartment below the grating. The dust is drawn through the grating by suction created by a fan. Seaming is the next process. The cotton threads are removed from the seams, together with all hard substances, such as buttons, hooks, eyes and buckles. Hand seaming has been largely succeeded by carbonizing. The rags should be colored before grinding. Shoddy colored in the rags always gives a longer staple, and makes a better and stronger yarn than shoddy which has been pickered. After the rags have been dyed and dried they are mixed and oiled. The oil is applied to soften the rags and allow the threads and fibers to slip more readily in the next operation of grinding.

The rag grinder, machine or picker consists of a pair of rollers between which the rags are firmly held as they pass into the machine. In front of the feed rollers is a rapidly revolving cylinder covered with steel teeth. These pins unravel and tear the rags apart into their component threads, and also shred the threads. The threads which have not been reduced to fiber by

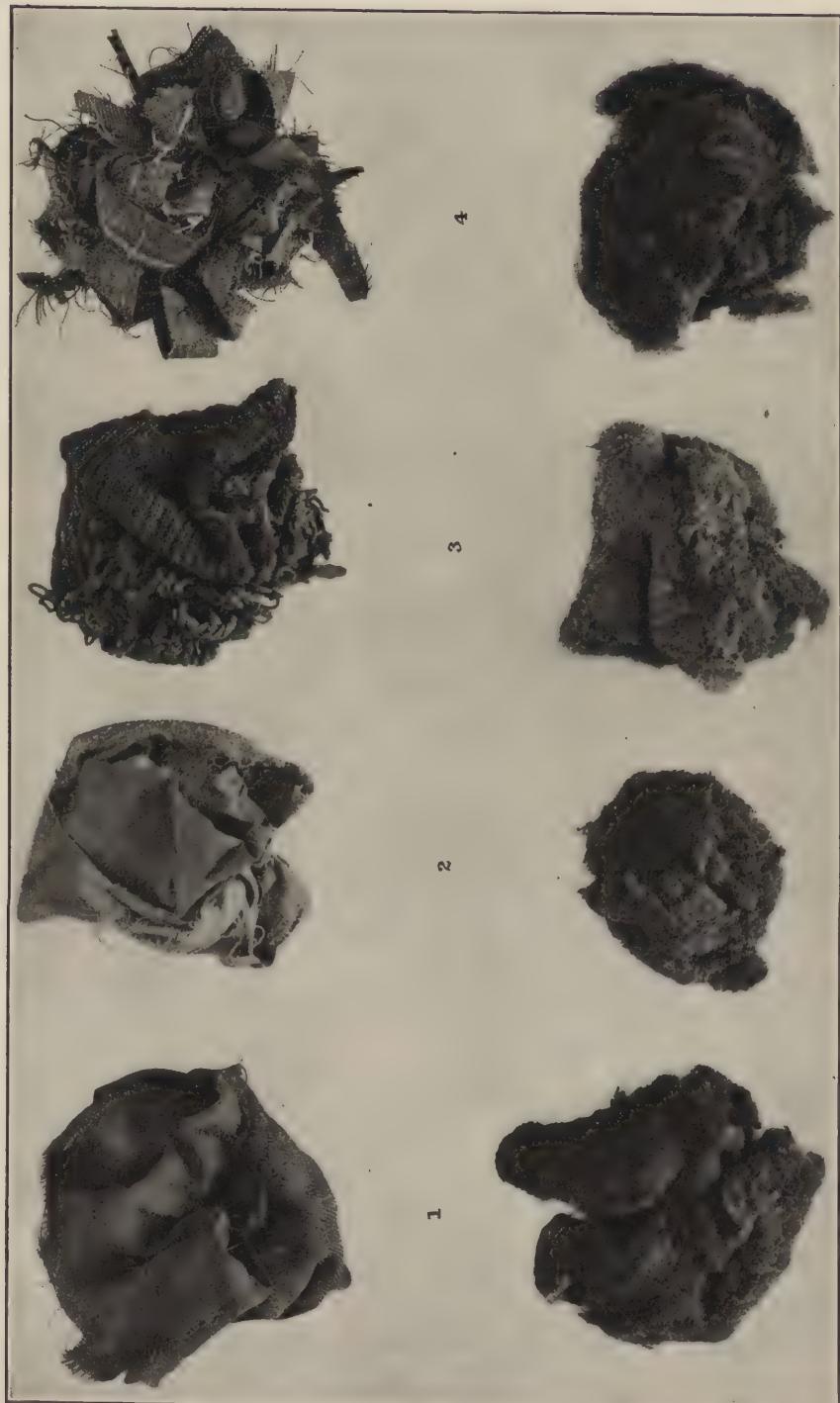


FIG. 81.—Types of Wool Rags and Substitutes.

1. Old Black Serge and shoddy made from it. 2. Fine Dark Merino and the resultant shoddy. 3. Old Sweaters and shoddy obtained

the picker are bursted and teased out when the stock is treated by a garnett machine or card. The latter is usually equipped with a breast, which is similar to a single garnett machine, and receives the stock from the feed rolls. In fact, many woolen mills using reclaimed stock equip their breaker cards with breasts.

The severe treatment naturally shortens the staple and tenders the fiber. Reclaimed fiber cannot be expected to possess the working properties of the original wool. The bulk of these products is made from colored rags and is used in the original color or redyed dark shades. One hundred pounds of rags will average about 75 pounds of reclaimed fiber.

There is no clear-cut classification of "shoddies" as with wools, yarns and tops. Reclaimed fiber products are as numerous as the combinations which may be made of rags with varying structure, color and condition. Reclaimed fiber products—namely, shoddy, mungo and extract wool—are designated by the name of the rag from which they were produced. New rags and tailor clippings produce a better product than old ones.

**164. Source of Rag Supply.**—New rags are obtained from custom tailors and ready-made clothing houses. They consist of the waste scraps and cuttings made in cutting up cloth. New rags are smaller than old rags, and consequently require more time in sorting.

Old rags are collected by junk dealers, who buy up a wide variety of old articles, such as bottles, newspapers, rags, etc., from households. The junk dealer sells his rags to a rag dealer, who separates the cotton and woolen rags. The latter are then sorted into three grades—soft woolens, skirted cloth and rough cloth. Soft woolens are made up of sweaters, stockings, hoods, soft dress goods, known as merinos, and similar soft and loosely woven all-wool fabrics. Skirted cloth includes hard-woven and fulled fabrics such as men's suits, heavy coats and cloakings. The term "skirted" in this case applies to the tearing out of the linings. Rough cloth consists of street rags and other coarse and worn-out fabrics. This class of rags is used in making the poorest

grades of reclaimed fiber, and is also ground up and used in making felt paper and machine waste.

**165. Mungo.**—This name is applied to reclaimed fiber obtained from woolen material which has been fulled or felted considerably. The same process as described for manufacturing shoddy is used in the preparation of mungo, but a more severe mechanical treatment is necessary in order to tear the fibers apart, and consequently it yields fibers of shorter staple and less value than the former. The fibers vary from  $\frac{1}{4}$  to  $\frac{3}{4}$  inch in length. Owing to its shortness it is seldom worked up alone into yarn but is mixed with longer wool or cotton and spun into low counts of filling yarn. As has been previously stated, the term "shoddy" is largely used in a loose way to include shoddy proper, mungo and extract wool, the latter two being classed as low-grade shoddies.

**166. Extract Wool.**—This product is made from rags containing a percentage of cotton. The rag may be a manipulated fabric, such as a woolen with cotton in the blend; a worsted made from a two-ply yarn, one thread of the ply yarn cotton and the other worsted; or a worsted fabric dressed end and end cotton and worsted. Union fabrics are another source of supply for this class of rags. They are made with cotton warps and worsted, wool, luster wool, mohair or alpaca fillings. Extract wool is processed in the same manner as shoddy, but carbonizing is an absolute requirement for the removal of the cotton.

There are two methods of carbonizing rags in use, the one being the treatment of the rags in a bath of sulphuric acid and the other subjecting them in the dry state to the action of hydro-chloric acid gas fumes. In the first method, after the rags have been sorted and then dusted or cleansed they are immersed in a solution of sulphuric acid (6° Tw.) at 140° to 180° F. The excess of acid is then removed by hydro-extracting, after which they are dried at a temperature of about 210° F. At this temperature the acid becomes concentrated and causes the vegetable matter to turn black and be reduced to a charred or carbonized

condition. The vegetable fibers are then easily dusted out by willowing, leaving the wool fibers scarcely affected. The excess of acid is next neutralized by treating the wool in a bath of soda-ash and washing thoroughly.

The sulphuric acid process is gradually being replaced by the more modern hydrochloric acid gas method of carbonizing. This latter method, besides being simple and convenient, enables the carbonizing to be carried out at a lower temperature so that the softness and luster of the wool fiber is better preserved. It also provides for treating the rags in the dry condition, which is of benefit to the wool, for in the sulphuric acid method the very thorough washing which is necessary to remove the acid is liable to damage the wool fiber by weakening or felting it. The apparatus employed consists of a large drum or cylinder revolving in an enclosed chamber and provided with some means for generating and supplying the hydrochloric acid gas, which passes through the rags and brings about the carbonization of the cotton or vegetable matter. After the rags have been treated with the hot acid gas they are run through a machine known as a "wincey," a centrifugal machine for shaking out the dust from the rags. They are then taken to the "shaker" machine and finally to the grinder.

Extract wool occurs in varying shades and qualities just as the shoddy and mungo from woolen rags. It does not have the felting property of these latter, but may be used either alone or blended with other reclaimed wool fibers in the production of lightly fulled goods.

**167. Market Quotations for Rags.**—The rag quotations, which will be found in the appendix, on page 233, furnish an excellent illustration of the many descriptions on the market, and show their comparative values.

**168. Market Quotations for Shoddy, Mungo and Extract Wool.**—A list showing the descriptions usually quoted with comparative prices will be found in the appendix, on page 235.

**169. Flocks.**—Three processes of woolen cloth finishing produce flocks. These are the fulling or milling, napping or gigging, and shearing or cropping operations. The flocks produced by the first two processes are much longer than shear flocks, and are used in cheap wool mixes. They consist of short fibers which have become detached from the fabric during fulling and gigging. Shear flocks are the very short protruding fiber ends cut from the surface of the cloth by the shear. The best shear flocks are obtained from fabrics with a raised or napped face, which is leveled by shearing. Shear flocks cannot be incorporated into yarn, and after passing through a machine which grinds them up into a powder they are used for weighting cheap heavyweight woolens. The method is to pour the flocks on the back of the tacked cloth while it is running in the fulling mill. The fulling action causes the flocks to distribute evenly and felt into the back of the cloth. Twice the weight of flock required is always used, as about half the quantity applied is left in the bottom of the fulling mill. With a 24 ounce low-grade overcoating, 4 ounces of flocks is not unusual. Flocks are also made by grinding rags.

Shear flocks vary in felting qualities; the best grades are obtained from sheared white fabrics made of fine virgin wool. Shear flocks are also used by wall-paper manufacturers in producing flock-papers, which consist of paper with raised figures resembling cloth. These figures are made from flocks and glue.

A typical market report for flocks will be found in the appendix. An excellent idea can be obtained of their relative value to other reclaimed fibers by comparing with some of the preceding market lists.

## CHAPTER IX

### FABRIC REQUIREMENTS AND HISTORICAL SYNOPSIS

#### 170. Wools Required for Various High Grade Established Fabrics.

BROADCLOTH	Warp, fine clothing, such as Ohio, Pennsylvania; filling, 6 months and 8 months fine Texas and similar
BILLIARD CLOTH	
DOESKIN	
CHINCHILLA	Warp, $\frac{1}{2}$ blood and above clothing; face filling, 6 months and 8 months fine Texas and similar
WHITNEY	
BED BLANKET	$\frac{1}{2}$ blood, $\frac{1}{2}$ blood, or fine clothing; 6 months and 8 months wools preferred in the filling
SWEATER	$\frac{1}{4}$ , $\frac{3}{8}$ or $\frac{1}{2}$ blood clothing or combing
CAR PLUSH	Mohair pile and cotton binder
WILTON	Pile, $\frac{1}{4}$ blood or $\frac{3}{8}$ blood combing; cotton and linen binders
BRUSSELS	
TAPESTRY	
VELVET	Common and $\frac{1}{4}$ blood carding
AXMINSTER	
KERSEY	$\frac{1}{2}$ blood to fine combing
THIBET	
FLANNEL	
PANAMA	
MELTON	
UNDERWEAR	$\frac{1}{2}$ blood to fine clothing
BEAVER	
VENETIAN	
COVERT	
CLAY SERGE	
GABARDINE	$\frac{3}{8}$ blood to $\frac{1}{2}$ blood combing
CREPE	
SERGE	$\frac{3}{8}$ blood to $\frac{1}{2}$ blood combing
WORSTED COATING	$\frac{1}{4}$ , $\frac{3}{8}$ or $\frac{1}{2}$ blood combing
WORSTED MEN'S WEAR	$\frac{3}{8}$ blood to $\frac{1}{2}$ blood combing
HENRIETTA	Silk warp; filling, fine combing mohair
MOHAIR COAT LINING	Cotton warp; combing mohair filling
ALPACA COAT LINING	Cotton warp; combing alpaca filling
LUSTER SERGE COAT LINING	Cotton warp; luster wool combing filling
MONTAGNAC	Vicuna
CHEVIOT SUITING	$\frac{1}{4}$ and $\frac{3}{8}$ blood Cheviot wool
CASSIMERE	$\frac{3}{8}$ blood clothing
MACKINAW	$\frac{1}{4}$ blood clothing wools of Cheviot nature
HOMESPUN	$\frac{1}{4}$ blood clothing
FRIEZE	$\frac{1}{4}$ blood clothing wools of Cheviot nature

## UNITED STATES ARMY FABRICS

FACING CLOTH .....	Fine clothing
DARK BLUE UNIFORM CLOTH .....	Fine clothing
OLIVE DRAB MELTONS .....	$\frac{3}{8}$ blood clothing
OLIVE DRAB SHIRTING FLANNEL .....	$\frac{1}{2}$ blood combing
OLIVE DRAB BLANKET .....	$\frac{3}{8}$ blood clothing
OLIVE DRAB SWEATER .....	$\frac{3}{8}$ blood combing

## 171. Historical Synopsis of the Wool-Growing Industry in the United States.

1700-1800.—The early colonists brought sheep of the down breeds to this country from England, but little attention was given to breeding and the sheep deteriorated.

1801-1803.—A few Spanish Merino rams and ewes were imported direct from Spain and France, but did not attract attention at first, as the wool was finer than required for the fabrics made in household manufacture.

1810.—Embargo on foreign goods caused great stimulus to woolen manufacturing industry in the United States. Until this time, homespuns and tweeds were the popular fabrics. Broadcloth became the popular fabric, and required fine Merino wools.

1810.—Price of Merino wool rose from 75 cents to \$2 per grease pound.

1810-1811.—The invasion of Spain by two hostile armies during the Napoleonic wars caused 20,000 pure-bred Merino sheep to be sold to Americans to prevent their confiscation by the armies, and the resulting total loss to the owners. Prior to this period, the Spanish Government prohibited the exportation of sheep, except when the King of Spain presented flocks to the principal crown heads of Europe. A few had also been smuggled out of Spain.

1812.—The War of 1812 threw the country completely on its own resources, and the household industry was taxed to capacity to supply cloth and blankets for the army. Broadcloth sold for \$8 to \$12 per yard. The popularity of broadcloth caused great

demand for fine Merino wool, and the wool-growing industry became important.

1810-1816.—This period showed great growth in woolen manufacturing, and consequent increase in flocks by demand for wool. The application of power to textile manufacturing gradually broke up the household industry, starting about 1800. The change was slow at first, and by 1816 only 5 per cent. of our textile manufactures were made in factories.

1825.—Opening of the Erie Canal connecting the Lakes with the Atlantic seaboard caused the development of the Ohio and Mississippi Valley sections as important wool-growing sections, as the Eastern markets could then be reached. Previous to this all wools not consumed by the grower had to be sent to New Orleans by river.

1833.—The Ohio Canal was opened from Portsmouth on the Ohio River to Cleveland on Lake Erie. This furnished an all-water route from the Mississippi River system to Atlantic markets, and was a great transportation improvement at the time.

1835.—London wool auctions established.

1840.—19,300,000 sheep in the United States, and yielded 45,000,000 pounds of wool.

1840.—The New England and Middle Atlantic States groups each contained one-third of all the sheep in this country. Twenty per cent. of all the sheep at this time were in the South, principally in Kentucky, Virginia and Tennessee. The remainder were in the "Northwest," principally Ohio.

1840.—Up until this time the East was the principal wool-growing section of the country, but from this time on the Middle West became important.

1845.—Worsted industry started in the United States, and worsted cloths commenced to find favor.



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FIG. 82.—Sheep Ranch in Lake Basin, near Billings, Montana.

1845.—The average number of sets of woolen cards per factory in the United States was 1.75 sets.

1845.—Miami Canal was opened from Cincinnati to Toledo. This canal relieved the congestion on the Ohio Canal.

1849-1854.—The gold and silver rush to California and Nevada caused the importation of large numbers of sheep to these States from the Middle West. These sheep were principally used for food.

1850.—Australia, New Zealand and Cape Colony became factors in the world's wool supply.

1850.—By 1850 the Middle West became an important factor in the wool production of this country, and this new source of supply caused a lowering in wool prices which hurt the industry in the East. Eastern wool growers could not compete with Western wool, as shelter and fodder had to be provided for the sheep during five months, and the grazing land averaged \$30 value per acre. The West used free public lands, and required little shelter and fodder. The tendency in the East to congregate in cities and towns and engage in industrial pursuits created excellent markets for vegetables and dairy products. This condition developed the planting of increased acreage in the East to supply city consumption, and less ground was available for grazing.

1850.—The blue grass region of Kentucky and Tennessee was principally confined to the English mutton breeds, which required richer pasturage than Merino sheep.

1855.—Railroads had crossed the Mississippi River into Iowa.

1850-1860.—The value of machine knitted products increased from \$1,000,000 in 1850 to \$7,000,000 in 1860 following the invention of the circular knitting machine in 1851.

1860.—The carpet industry gradually developed from 1825 until 1860, when 9,000,000 pounds of wool were used. Ingrains consumed the bulk of this wool.

1860.—About this time mutton came into demand for food, and sheep owners turned to raising the English mutton breeds in place of Merinos. Broadcloth had ceased to be a popular staple fabric, but has since had periods of popularity caused by the dictates of fashion and style. The decline in popularity of broad-cloth caused a lack of demand for fine wool. Worsted succeeded broadcloth in public favor, and required a longer stapled and coarser wool. The English breeds furnished the required wool for worsteds, and also furnished better mutton. The most popular English breeds at this time in the United States were the Southdown, Cotswold and Leicester.

1860.—Wool-growing industry in the East in a declining state.

1860.—Household manufacture of wool had practically disappeared by 1860, due to improved power machinery, better transportation and distributing facilities, which afforded the manufacturer a wider and larger market.

1860.—Many growers of Merino wool turned to the Rambouillet or French Merino at this time, owing to its closer approach to the demands of the time for better mutton.

1860.—Just prior to 1860 Texas became an important wool-producing State. Practically all wool grown in other Southern States up to 1860 was consumed in household manufacture, and the supply was only sufficient for local consumption, and of poor quality, burly and coarse. The climate of the South is better adapted to agriculture, specializing in cotton, tobacco, sugar and rice.

1860.—Consumption of wool in the United States amounted to 100,000,000 pounds. One-half of this quantity was grown in this country.

1860.—Wool growing was firmly established in California and Oregon.

1860.—Argentina and Uruguay became important factors in the world's wool supply.

1861-1866.—The Civil War caused the New England and Middle Atlantic States, where the sheep industry had badly retrograded, to practically double their flocks. The cotton famine in the North caused wool to be used for many purposes to replace cotton. It has been estimated that each Union soldier averaged fifty pounds of grease wool per year.

1867.—The close of the Civil War caused a reaction in the demand for wool with the return of cotton as a manufacturing raw material. The stimulus given to the demand for wool by the large army requirements was removed by the discharge of most of the troops.

1867.—This year marked the height of the supremacy in wool growing by the loyal States east of the Rockies. There were 36,000,000 sheep in the United States in 1867. Wool prices dropped very low, and great numbers of sheep were slaughtered for meat.

1867-1871.—The Civil War caused the flocks to increase 140 per cent. by 1867, but by 1871 the reaction reduced these same flocks 45 per cent.



FIG. 83.—Ewes and Lambs on the Range, Canada.

1867-1871.—Another cause for the decline in flocks during this period was the increase in value of all other important agricultural products, while wool and mutton decreased in price.

1870.—The sheep industry in this country started in the hill regions of the East and started westward to the Middle West during the 1830s. About 1870 the sheep industry started to move westward again and located in the Far West. By 1890 this movement was completed and the Far West seems destined to remain the principal wool-growing section of the United States.

1870.—There were about 28,500,000 sheep in the United States in 1870, distributed as follows: New England, 1,450,000; Middle Atlantic States, 4,248,000; North Central States, 11,164,000; Central West States, 2,473,000; Southern States, 5,188,000, and Far Western States, 3,949,000.

1871.—The number of sheep in this country dropped to 22,500,000 in 1871.

1870-1890.—The general range of wool prices was low, due to panics and great increase in flocks of the United States, River Platte region and Australia. During this period, American wool came nearer to supplying the requirements of the home market than at any time since the early part of the nineteenth century.

1870-1890.—The South just held its own during this period. The main wool-producing States in this section were Kentucky and Tennessee.

1880.—The flocks of Utah, Idaho, Montana and Wyoming reached large proportions by 1880. The Intermountain States are best adapted physically and economically to wool growing, as the character of the land is less adapted to farming than other parts of the country.

1880.—This year was the high-water mark of the wool-growing industry in California.

1880-1885.—This period produced great increases in the flocks of the United States, River Platte region and Australia.

1882.—The frozen mutton trade with Argentina and New Zealand caused a tendency to crossbred wools which has reduced the world's supply of the finest Merino wool.

1884.—The number of sheep in the United States reached 51,000,000 head in 1884, and is the greatest number in our history.

1885.—The influx of a large farming population drove many sheep owners out of Texas to the Far West, as the free grazing lands disappeared in Texas.

1885.—This year found 26,000,000 sheep in the Far West. The estimated annual cost of keeping sheep in 1885 in the Northern and Eastern States was \$2.65 per head and on the Western ranges only 50 cents per head.

1890.—Mutton sheep, mostly Southdowns and Shropshires, had largely replaced Merinos in Ohio, Illinois, Indiana and Michigan by 1890.

1890.—There were 48,000,000 sheep in the United States in 1890; one-half of these were in the Far West and one-quarter in the Middle West.

1893.—The business panic of 1893 caused the price of wool to drop one-third.

1894.—The admission of foreign wool free of duty under the Wilson Bill in 1894 was followed by a 50 per cent. decline in the value of wool grown in this country.

1914.—The European War has caused an increase of about 50 per cent. in wool values. Of late years the supply of fine wools has been far below the demand, and some breeders are turning their efforts again to growing fine wool.

1915.—Introduction of the Australian method of shearing and preparing wools may lead to its adoption by the entire Far West, and help to prevent any further decline in the industry in its last stronghold in this country.

1923.—In this year the number of sheep in the United States, according to official estimates, was 38,347,000, and the wool produced, according to the latest available reports and estimates, was 266,110,000 pounds.

**172. Economic Necessity for a Greater Sheep Industry in the United States.**—Many causes have directly and indirectly brought about the decline in the wool production of this country. Our wool production supplies a little over one-third of the amount annually consumed, and it is necessary to import from 300,000,000 to 500,000,000 pounds annually to supply this demand. While the number of sheep and the wool production are continually decreasing, our population and consequent wool consumption are continually increasing, and the proportionate amount of wool to be imported is therefore constantly growing larger.\*

For several decades the western part of our United States has furnished two-thirds of our total wool clip, with two States—namely, Montana and Wyoming—producing one-fifth of our total production. The opening of the West, following the close of the Civil War, afforded unlimited free pasturage to millions of sheep. The sheep owner was under comparatively small expense for the maintenance of his flocks. The sheep industry under such conditions was bound to be profitable, except in rare instances where the flocks were destroyed by blizzards or long droughts. Although large numbers of sheep annually fall prey to coyotes in the West, the decline of the sheep industry there cannot be attributed to coyotes, as they are less numerous now than twenty or thirty years ago.

The most important factor in the reduction of the wool clip in the West is undoubtedly the encroachment of farms. The

\* Sheep raising for wool fiber, however, in the United States does not seem to be on the increase, but on the contrary the wool production during recent years has been decreasing. The consumption of wool in the United States during 1922 was about 803,000,000 lbs., or somewhat over 7 lbs. per capita. During the same year the United States produced only about 250,000,000 lbs. of wool and had, consequently, to import about 550,000,000 lbs. In 1923 the United States produced about 300,000,000 lbs. of wool, so that notwithstanding the considerable increased consumption of wool in this country, its cultivation and production has steadily declined.

farms have pushed farther and farther into the sheep country and have greatly reduced the size of the open ranges. The Federal Government has also seen fit to withdraw from public use about 225,000,000 acres in the West. These include Indian reservations, national forests and parks, and natural resources, such as power sites, mineral deposits, oil and coal lands. In addition, the development of large arid tracts by means of irrigation has been another factor in the reduction of available sheep-grazing lands in this region. With increasing land values the sheep industry is supplanted by farming. There are large sections in the Intermountain States which are only suited for sheep grazing, and will indefinitely continue as such, but unless the present influences are removed the sheep industry in the West will continue to show a heavy decline.

The conditions in the farming States of the East, Middle West and South are of an entirely different nature. Since 1870 none of these sections has possessed a sheep industry on a large scale. In these States sheep raising is only incidental to general farming. In the United States only one farm out of seven carries sheep, and the average number of sheep per farm in this country in 1910 was 8.14. The farm flock usually ranges from 25 to 100 head. Practically all the sheep in the farm States are raised with mutton as the primary object. The quality and value of the wool produced by such sheep is of secondary importance to the owner. The bulk of these sheep belong to the various British breeds, and do not produce fine wools. Most of these wools are  $\frac{3}{8}$  blood and  $\frac{1}{4}$  blood combing.

The greatest decline has been in the East and Middle West. The contributing causes are several in number. The high values of farm lands have made it impossible to make sheep raising on a large scale a profitable business in these sections, as the cost of maintaining a flock on a farm is excessive when compared with the cost on the ranges in the West.

Large numbers of sheep are annually run to death by dogs in the farm States. Further damage is caused by these dogs fright-

ening sheep, thereby throwing them off their feed and often causing them to fail during breeding season. There is no doubt that the trouble and losses caused by dogs have been the reason for many farmers disposing of their sheep.

Another important factor in the elimination of sheep from the farm has been the increasing preferment shown by the farmers for dairy and beef cattle.

The demand for mutton is not nearly so great as that for beef and pork. The wide fluctuations in the prices of mutton and wool have also caused many farmers to become discouraged with sheep raising.

The conditions and high prices caused by the European War have focused the attention of the consuming public, as well as those interested in the producing and manufacturing of wool to a realization of the economic importance of the wool situation in this country. The embargo placed on the exportation of wool by Great Britain during the European War has caused a scarcity in this country, as the only large producing section not affected by this embargo was South America. As the large wool-producing sections of the world seemed to have reached their limit, a steady decline in the wool production from Australia, South America and South Africa may be expected as these sections become more thickly populated and increase their farming area. The question of a sufficient wool supply is not only concerning this country, but is of equal importance to the rest of the civilized world. There is no doubt but that the wool situation in this country would have reached a critical condition many years ago if the average weight per fleece had not been doubled during the past fifty years by selection in breeding.

Wool is an absolute necessity for many articles of clothing, and as there is no possibility that a satisfactory artificial substitute will be invented, something must be done to increase the wool production. As previously stated in describing the reasons for the decline of the sheep industry in the West, there is no chance for relief in that section of the country. All authorities have

agreed that an increased wool production in this country must be developed in the farming States of the East, Middle West and South. The United States Department of Agriculture and State Agricultural Colleges have distributed useful pamphlets on the selection of breeding stock and the care of sheep as well as the advantages secured to the farmer from sheep raising. It is expected that the extensive educational program developed through agricultural and live-stock journals, agricultural college extension bureaus, demonstration cars, boys' lamb-club prizes and the county farm agents of the United States Department of Agriculture will interest the farmers to maintain small flocks of sheep.

The raising of sheep on the farm offers numerous advantages. Sheep will graze on hilly and rough ground which is unsuitable for agriculture or cattle pasture. They also keep down the fence rows and greatly increase soil fertility. Sheep require slight attention except at lambing time, which usually comes during the early spring before the work in the field starts. The presence of sheep makes fresh meat available for the farmers' table all year round. Sheep annually yield two money crops, lambs and wool.

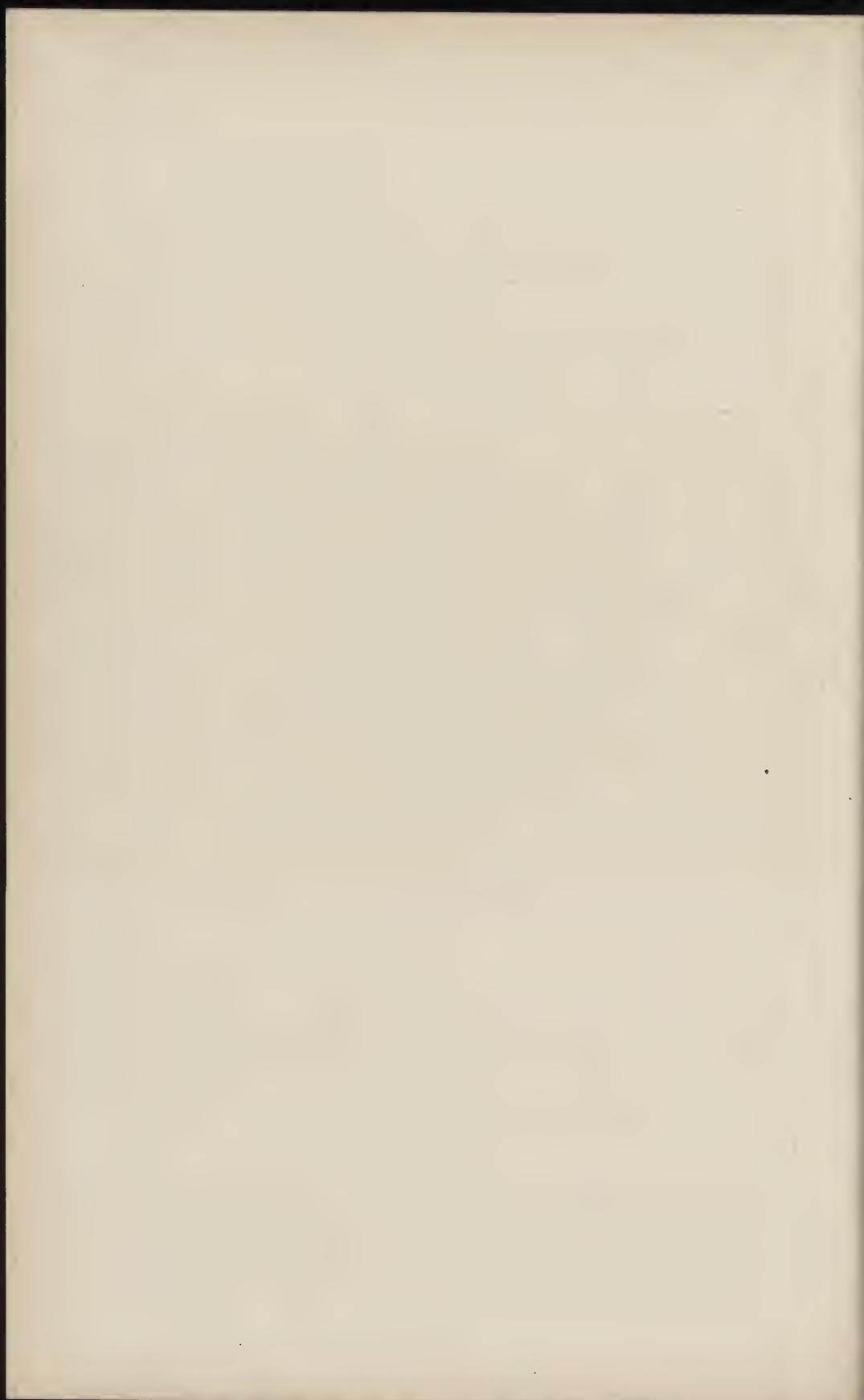
There are millions of acres of land in the United States which are at present non-productive, but could be utilized for sheep grazing. Extensive areas of deserted stump land are available for this purpose. The Appalachian Mountain district, extending from the Catskills to Georgia, offers excellent opportunities for the profitable raising of sheep. This region is sparsely populated and comparatively few sheep are found there. It is hardly possible that the South will increase its flocks extensively, as many of the States are better suited for producing cotton, tobacco, sugar-cane, rice and corn.

If one-fourth of the farms now without sheep maintained flocks to the number which now averages on the farms keeping sheep there would be enough wool produced to make this country independent of the rest of the world. However, carpet wools would continue to be imported, as it would never be advisable to maintain the class of inferior sheep which produce these cheaper wools.

The State Legislatures have been urged to enact suitable laws for curbing the dog menace and a strict enforcement of existing dog laws is demanded.

This country has about reached the point where it must curtail waste and halt the exploitation of its natural resources. Our increasing population and the increased cost of living will force the adoption of the economic methods employed in Europe. The British Isles, with an area less than the State of Texas, produce more wool on a scoured basis than the wool-producing territory of the United States. In the British Isles there is one sheep for every two acres, and for every one and one-quarter inhabitants there is one sheep. Scientific management, co-operative marketing and more stable prices, with a possibility of governmental regulation, will be the new program which will supplant the individualism of the past and present. There is no doubt that when this era arrives the true value of sheep on the farm will be recognized, but the best interests of the country should be served now by increasing the number of sheep to such a point that the United States is able to produce sufficient wool for home consumption. At the present time, wool is the only important raw material which is a basic necessity that is not produced in sufficient quantity to satisfy our home requirements. A wool supply is a vital factor in national preparedness.

## APPENDIX



## APPENDIX

TABLE A

IMPORTATION AND PRODUCTION OF FLEECE AND PULLED WOOL IN UNITED STATES,  
1913-1923

Total Imports Fiscal Year, June 30 Pounds	Production in U. S. Washed & in Grease Pounds	Scoured Estimate of Product Pounds	Average Percentage of Shrink
1913-14 . . . . . 247,648,869	296,175,300	132,022,080	55
1914-15 . . . . . 308,083,429	290,192,000	131,840,680	55
1915-16 . . . . . 534,828,022	288,777,000	131,987,960	54
1916-17 . . . . . 372,372,218	288,490,000	130,755,750	56
1917-18 . . . . . 379,129,934	285,573,000	129,431,055	55
1918-19 . . . . . 422,414,664	299,921,000	130,611,290	57
1919-20 . . . . . 427,578,038	314,239,000	138,037,484	56
1920-21 . . . . . 318,235,873	302,207,000	137,315,165	54
1921-22 . . . . . 255,087,236	273,064,000	126,021,000	54
1922-23 . . . . . 525,472,657	261,095,000	119,228,950	54
1923 . . . . .	266,110,000	121,652,000	54

TABLE B

UNITED STATES WOOL IMPORTS SHOWING COUNTRY OF PRODUCTION,  
FISCAL YEAR, JUNE 30, 1923

	Pounds	Pounds
England . . . . .	23,564,803	Turkey in Asia . . . . . 5,308,652
Scotland . . . . .	19,284,326	British South Africa . . . . . 27,124,346
France . . . . .	5,264,596	Argentine . . . . . 96,976,725
Germany . . . . .	4,182,853	Chile . . . . . 9,416,524
Iceland . . . . .	1,621,207	Peru . . . . . 2,906,864
Russia in Europe . . . . .	4,305,657	Uruguay . . . . . 48,643,416
Spain . . . . .	1,647,759	Australia . . . . . 102,991,474
Turkey in Europe . . . . .	5,845,156	New Zealand . . . . . 38,876,856
British India . . . . .	28,729,906	All others . . . . . 19,312,508
China . . . . .	67,350,907	Total . . . . . 525,472,657

TABLE C

CARPET WOOLS IMPORTED BY THE UNITED STATES, FISCAL YEAR ENDED  
JUNE 30, 1923

	Pounds	Pounds
China . . . . .	65,620,669	Germany . . . . . 3,893,451
Russia (Europe and Asia) . . . . .	4,230,274	France . . . . . 4,156,895
United Kingdom . . . . .	28,856,216	Iceland and Faroe Islands . . . . . 1,620,255
Turkey (Europe and Asia) . . . . .	5,820,802	All others . . . . . 20,426,673
British East Indies . . . . .	28,543,200	Total . . . . . 171,879,192
Argentina . . . . .	8,710,757	

TABLE D

## IMPORTS OF RIVER PLATTE WOOLS INTO THE UNITED STATES, 1915-1923

## ARGENTINA:

	Pounds
1915	77,808,253
1916	129,163,353
1917	207,970,092
1918	181,154,575
1919	139,451,795
1920	139,225,920
1921	104,023,117
1922	32,386,855
1923	96,976,725

## URUGUAY:

	Pounds
1915	16,597,623
1916	9,508,746
1917	37,601,961
1918	18,409,011
1919	41,107,665
1920	47,307,367
1921	36,186,291
1922	23,390,488
1923	48,537,170

TABLE E

## WOOL IMPORTED INTO BOSTON, NEW YORK AND PHILADELPHIA BY PORTS AND CLASSES. FISCAL YEAR 1922-23

	Class I	* Class II	Class III	Totals
Boston	26,872,837	260,288,500	21,092,186	308,253,523
New York	4,484,574	22,314,040	80,943,214	107,741,828
Philadelphia	5,828,968	23,560,777	60,170,702	89,560,447
				505,555,798

NOTE: These figures represent 96.2 per cent. of the total quantity of wool imported into all the ports of the United States.

In 1923, fiscal year, the imports at all ports were:

Clothing, Class I	43,703,289
Combing, Class II	298,496,152
Mohair	11,394,024
Carpet, Class III	171,879,192
Total	525,472,657

TABLE F

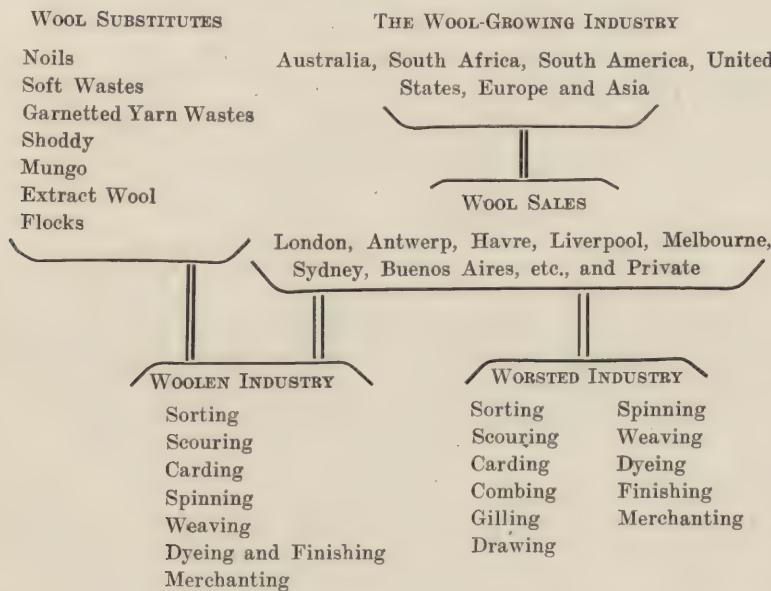
IMPORTS BY GRAND DIVISIONS, FISCAL YEAR ENDED JUNE 30, 1923  
ANNUAL WOOL REVIEW, NAT. ASS'N WOOL MANUFACTURERS

Places of Production	Class I Clothing Pounds	Class IIa Combing Pounds	Hair of the Angora goat, alpaca, etc. Pounds	Class III Carpet Pounds	Total Pounds
Europe	5,515,134	14,687,020	3,536,905	56,036,245	80,055,447
Asia	371,294	1,222,598	2,528,464	103,937,066	108,059,422
Africa	2,208,781	20,706,618	3,903,212	1,542,513	28,361,124
North America	3,168,064	5,263,214	16,124	523,666	8,971,068
South America	16,342,899	131,635,819	1,076,193	9,102,355	158,157,266
Australia	16,097,117	124,980,883	333,126	457,204	141,868,330
Totals	43,703,289	298,496,152	11,394,024	171,599,049	525,472,657

\* Includes Mohair.

TABLE G

# GRAPHIC CHART OF WOOLEN AND WORSTED INDUSTRIES



## MONTHLY FLUCTUATING PRICES OF WOOL, 1913 AND 1919-1923

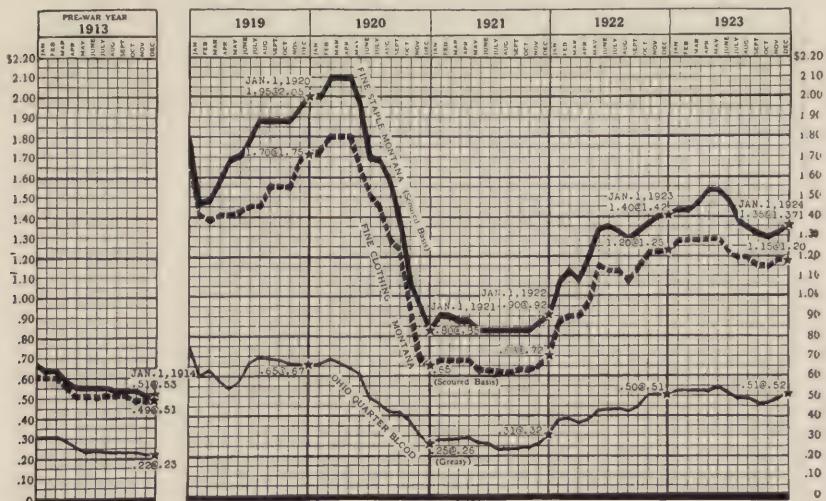


TABLE H  
WOOL PRODUCT OF THE UNITED STATES—1918

States	Quality	Estimate of U. S. Dept. of Agriculture			Per Cent.	Equivalent Quantity of Scoured Wool Pounds.	Av. Value per Pound, Oct. 1 1916 Cents	Av. Value per Secured Pound, Oct. 1 1917 Cents	Total Value, 1918 Cents
		Number of Fleeces	Av. Weight per Fleeces Pounds	Raw Wool of Product Shrink- age Pounds					
Maine	10% fine, 90% medium...	132,000	6.7	883,000	42	512,140	80	135	135
New Hampshire	5% fine, 95% medium...	27,000	7.0	192,000	43	109,440	78	134	134
Vermont	20% fine, 80% medium...	92,000	7.2	663,000	48	344,760	81	140	140
Massachusetts	Medium	20,000	6.0	119,000	42	69,760	80	135	135
Rhode Island	Medium	4,000	6.0	24,000	41	14,160	80	135	135
Connecticut	Medium	14,000	5.5	76,000	41	44,840	80	135	135
New York	30% fine, 70% medium...	547,000	7.0	3,830,000	49	2,053,300	85	145	145
New Jersey	Medium	16,000	5.5	88,000	41	51,920	85	145	145
Pennsylvania	60% fine, 40% medium...	713,000	6.7	4,774,000	51	2,339,260	87	152	152
Delaware	Medium	5,000	5.7	31,000	41	18,290	80	135	135
Maryland	Medium	133,000	5.8	773,000	41	456,070	80	135	135
West Virginia	75% fine, 25% medium...	544,000	5.2	2,830,000	50	1,415,000	87	152	152
Kentucky	Medium	624,000	4.9	3,058,000	39	1,865,380	80	135	135
Ohio	65% fine, 35% medium	1,726,000	7.3	12,600,000	53	5,922,000	86	150	150
Michigan	25% fine, 75% medium...	1,184,000	7.4	8,765,000	50	4,382,500	85	145	145
Indiana	Medium	671,000	7.1	4,765,000	45	2,620,750	80	135	135
Illinois	10% fine, 90% medium...	506,000	8.0	4,048,000	49	2,064,480	81	137	137
Wisconsin	5% fine, 95% medium...	375,000	7.6	2,850,000	46	1,311,000	80	135	135
Minnesota	5% fine, 95% medium...	421,000	7.4	3,112,000	50	1,556,000	78	130	130
Iowa	10% fine, 90% medium...	642,000	7.5	4,815,000	50	2,407,500	80	135	135
Missouri	5% fine, 95% medium...	790,000	7.0	5,532,000	45	3,042,600	80	134	134
		9,186,000	6.95	63,828,000	49.0	32,600,410	..	..	..
Virginia	Medium	408,000	4.7	1,918,000	38	1,189,160	81	137	135
North Carolina	Medium	142,000	4.0	570,000	42	330,600	75	132	122
South Carolina	Medium	26,000	4.0	103,000	42	59,740	75	132	122
Georgia	Medium	165,000	2.9	478,000	42	277,240	76	133	122
									\$46,126,959

## APPENDIX

Florida	.....	Medium	.....	133,000	3.2	426,000	42	247,080	75	132	122	301,438
Alabama	.....	Medium	.....	105,000	3.5	318,000	41	217,120	75	132	122	264,886
Mississippi	.....	Medium	.....	155,000	4.0	619,000	41	365,210	75	132	122	445,556
Louisiana	.....	Medium	.....	161,000	3.7	594,000	44	332,640	75	132	122	405,821
Arkansas	.....	Medium	.....	82,000	4.9	402,000	44	225,120	74	130	130	292,656
Tennessee	.....	Medium	.....	425,000	4.6	1,954,000	41	1,152,860	78	134	130	1,498,718
				1,802,000	4.12	7,432,000	59.2	4,396,770	..	..	..	5,628,889
Kansas	.....	Fine, fine med., and med.	.....	214,000	7.6	1,624,000	63	600,880	85	150	150	901,320
Nebraska	.....	Fine, fine med., and med.	.....	217,000	7.8	1,696,000	64	610,560	85	150	150	915,840
South Dakota	.....	Fine, fine med., and med.	.....	641,000	7.4	4,747,000	60	1,898,800	83	152	152	2,886,176
North Dakota	.....	Fine, fine med., and med.	.....	205,000	7.6	1,560,000	63	577,200	83	150	150	865,800
Montana	.....	Fine, fine med., and med.	.....	2,847,000	8.2	23,342,000	64	8,403,120	86	155	155	13,024,836
Wyoming	.....	Fine, fine med., and med.	.....	4,051,000	8.4	34,026,000	67	11,298,580	85	153	153	17,179,727
Idaho	.....	Fine, fine med., and med.	.....	2,468,000	7.9	19,500,000	63	7,215,000	85	153	153	11,038,950
Washington	.....	Fine, fine med., and med.	.....	640,000	8.6	5,504,000	69	1,706,240	84	151	151	2,576,422
Oregon	.....	Fine, fine med., and med.	.....	1,562,000	8.0	12,500,000	67	4,125,000	85	156	156	6,435,000
California	.....	33% fall, 67% spring.	.....	1,792,000	7.0	12,545,000	64	4,526,200	83	150	150	6,789,300
Nevada	.....	Fine, fine med., and med.	.....	1,429,000	7.0	10,000,000	70	3,000,000	85	153	150	4,500,400
Utah	.....	Fine, fine med., and med.	.....	2,052,000	7.7	15,800,000	65	5,530,000	84	151	151	8,350,300
Colorado	.....	Fine, fine med., and med.	.....	1,494,000	6.2	9,261,000	63	3,426,570	83	150	150	5,139,855
Arizona	.....	Fine, fine med., and med.	.....	927,000	6.1	5,656,000	65	1,979,600	85	153	153	3,028,788
New Mexico	.....	Fine, fine med., and med.	.....	3,059,000	5.6	17,132,000	68	5,482,240	83	150	150	8,223,360
Texas	.....	25% fall, 75% spring.	.....	1,007,000	7.0	11,250,000	67	3,712,500	82	150	150	5,568,750
Oklahoma and Indian Territory	Fine, fine med., and med.	.....	76,000	6.8	518,000	63	191,660	82	150	150	287,490	
				25,281,000	7.30	186,661,000	65.6	64,214,150	..	..	..	\$97,711,914
Totals	.....	.....	36,269,000	7.11	257,921,000	60.8	101,211,290	84.6	\$1,482	\$1,486	\$149,467,762	
Pulled Wool	.....	.....	.....	42,000,000	30	29,400,000	75.5	1,507	1,52	1,52	44,692,000	
Total Product. 1918	.....	.....	.....	299,921,000	..	130,611,290	82.5	1,487	1,487	1,487	194,159,762	
							29.4+	.673*	.647*	.559+	.564†	

\* Equivalent value, unwashed. † Farm value as estimated by the Department of Agriculture.

TABLE I

DISTRIBUTION OF UNITED STATES SHEEP BY STATE GROUPS  
Compiled by the Philadelphia Wool and Textile Association



NUMBER OF SHEEP, SHEARING AGE

	1901	1915	1923
1. North Atlantic States .....	2,451,000	1,636,000	1,293,000
2. South Atlantic States .....	1,424,000	1,606,000	1,075,000
3. Central States .....	7,203,000	6,305,000	6,363,000
4. Southern States .....	3,831,000	3,256,000	4,331,000
5. Western States .....	11,441,000	10,470,000	12,613,000
6. Northwestern States .....	15,553,000	13,395,000	11,548,000
Total .....	41,903,000	36,668,000	37,223,000

TABLE J

UNITED STATES SHEEP RECORDS BY DECADES

	Farms	Sheep	Sheep Per Farm	Sheep Per Capita
1850.....	1,450,000	21,773,000	15.0	.93
1860.....	2,044,000	22,471,000	10.9	.71
1870.....	2,660,000	40,859,000	15.3	1.65
1880.....	4,009,000	40,766,000	10.1	.81
1890.....	4,564,000	44,336,000	9.7	.70
1900.....	5,740,000	41,884,000	7.2	.54
1910.....	6,340,000	51,638,000	8.14	.56
1920.....	6,448,343	39,025,000	5.43	.33

TABLE K

RELATIVE STANDING OF LEADING WOOL-PRODUCING STATES, ARRANGED  
ACCORDING TO NUMBER OF SHEEP, 1900, 1910 AND 1920

STATES	1900	1910	1920	STATES
1 New Mexico.....				<b>Idaho</b> .....
2 Montana .....				<b>Texas</b> .....
3 Wyoming .....				<b>New Mexico</b> .....
4 Ohio .....				<b>California</b> .....
5 Idaho .....				<b>Wyoming</b> .....
6 Oregon .....				<b>Oregon</b> .....
7 Texas .....				<b>Utah</b> .....
8 Utah .....				<b>Ohio</b> .....
9 Colorado .....				<b>Colorado</b> .....
10 California .....				<b>Montana</b> .....
11 Michigan .....				<b>Missouri</b> .....
12 Arizona .....				<b>Michigan</b> .....
13 New York.....				<b>Arizona</b> .....
14 Pennsylvania ....				<b>Nevada</b> .....
15 Washington .....				<b>Iowa</b> .....
16 Wisconsin .....				<b>South Dakota</b> ....
17 Indiana .....				<b>Kentucky</b> .....
18 Nevada .....				<b>Indiana</b> .....
19 Illinois .....				<b>Illinois</b> .....
20 Iowa .....				<b>Washington</b> .....
21 Missouri .....				<b>New York</b> .....
22 Kentucky .....				<b>Nebraska (b)</b> .....
23 West Virginia....				<b>West Virginia</b> .....
24 Minnesota .....				<b>Minnesota</b> .....
25 South Dakota ....				<b>Pennsylvania</b> .....
26 Virginia (a).....				<b>Wisconsin</b> .....
27 North Dakota (a).				<b>Tennessee (b)</b> .....

(a) Among the first 27 States in 1900 and 1910, but not in 1920.

(b) Among the first 27 States in 1920 only.

TABLE L

COMPARATIVE CHART OF UNITED STATES WOOL AND SHEEP STATISTICS, 1901-1920

Compiled by Philadelphia Wool and Textile Association

NUMBER OF SHEEP, SHEARING AGE

1901	41,900,000
1906	38,540,000
1911	39,481,000
1915	36,600,000
1920	39,025,000

DOMESTIC WOOL PRODUCTION

1901	302,000,000	Pounds
1906	298,000,000	"
1911	318,000,000	"
1915	288,000,000	"
1920	277,905,000	"

## VALUE OF PRODUCT

1901	\$51,000,000
1906	\$80,000,000
1911	\$67,000,000
1915	\$85,000,000
1920	\$113,000,000

## ESTIMATED CONSUMPTION

1901	400,000,000 Pounds
1906	491,000,000 Pounds
1911	510,000,000 Pounds
1915	591,000,000 Pounds
1920	516,041,442 Pounds

TABLE M

## WOOL PRODUCTION OF THE WORLD ACCORDING TO THE LATEST AVAILABLE REPORTS AND ESTIMATES

Country	Year	Pounds
<b>NORTH AMERICA:</b>		
United States	1923	266,110,000
British Provinces	1923	15,539,416
Total North America		<u>281,649,416</u>
<b>CENTRAL AMERICA AND WEST INDIES:</b>		
Mexico	1923	780,000
All other		<u>750,000</u>
Total Central America and West Indies		<u>1,530,000</u>
<b>SOUTH AMERICA:</b>		
Argentina	1922-23	297,000,000
Brazil	1922	23,800,000
Chile	1922	38,500,000
Columbia	1917	860,000
Peru	1922	10,000,000
Falkland Islands	1923	3,200,000
Uruguay	1922	92,000,000
All other		<u>5,000,000</u>
Total South America		<u>470,360,000</u>
<b>EUROPE:</b>		
Austria	1923	1,322,760
Belgium	1922	826,725
Bulgaria	1922	25,000,000
Czechoslovakia	1920	4,303,000
Denmark, Iceland and Faroe Islands	1921	3,508,000
Esthonia	1923	3,150,000
Finland	1922	7,500,000
France	1923	41,777,000

Country	Year	Pounds
<b>EUROPE—Continued:</b>		
Germany	1922	48,501,000
Greece	...	13,000,000
Hungary	1923	13,779,000
Italy	1922	58,000,000
Latvia	1923	2,700,000
Netherlands		5,100,000
Norway	1923	5,200,000
Poland	1923	5,839,000
Portugal	1923	6,000,000
Roumania	1923	52,910,000
Russia	1923	87,465,000
Spain	1922	90,364,000
Sweden	...	2,700,000
Switzerland	1923	780,000
United Kingdom	1923	102,300,000
Yugoslavia	1921	35,000,000
All other	...	100,000
 Total Europe		 617,125,485
<b>ASIA:</b>		
British India	1923	65,000,000
China	1923	78,000,000
Japan	1923	72,276
Persia	1923	18,000,000
Russia in Asia	1923	45,000,000
Turkey in Asia	...	60,000,000
All other	...	1,000,000
 Total Asia		 267,072,276
<b>AFRICA:</b>		
Algeria	1922	35,155,000
Egypt	1921	4,500,000
Morocco	1923	19,976,000
Tunis	...	6,765,000
Union of South Africa	1922-23	176,000,000
All other	...	25,000,000
 Total Africa		 267,396,000
<b>OCEANIA:</b>		
Australia	1922-23	600,931,156
New Zealand	1922-23	214,705,920
 Total Australasia		 815,637,076
All other	...	70,000
 Total Oceania		 815,707,076
 Total World		 2,720,840,253



FIG. 84.—Map of World—Geographic Distribution of Sheep and Sources of Wool.

TABLE N

Boston prices of domestic wools in October for the last eleven years are shown in the table which follows:

COMPARATIVE PRICES OF DOMESTIC WOOLS IN BOSTON, OCTOBER, 1913-1923.

	1923	1922	1921	1920	1919	1918	1917	1916	1915	1914	1913
Ohio, Pennsylvania and West Virginia (Unwashed) :											
Fine .....											
Fine	.48	.46	.28-29	.42	.67	.67	.63	.32-.33	.26-.27	.23	.24
1/2 blood	.54	.55	.30-.31	.42	.80	.78	.75	.39-.40	.34-.35	.27	.28
3/8 blood	.51	.50	.26-.27	.40	.67	.78	.75	.40-.42	.36-.37	.26	.27
1/4 blood	.48	.45	.25-.26	.38	.64	.77	.75	.40-.42	.35-.36	.26	.27
Fine Delaine	.54	.55	.35-.36	.60	.83	.75	.75	.36-.37	.30-.31	.24	.25
Michigan, Wisconsin, New York, etc. (Unwashed) :											
Fine	.46	.45	.26-.27	.40	.65	.64	.60	.29-.30	.24-.25	.22	.23
1/2 blood	.52	.51	.28-.29	.40	.75	.76	.74	.37-.38	.33-.34	.26	.27
3/8 blood	.50	.48	.26-.27	.38	.60	.77	.74	.41-.42	.35-.36	.26	.27
1/4 blood	.46	.43	.24-.25	.36	.60	.76	..	.40-.41	.34-.35	.25	.26
Fine Delaine	.51	.52	.32-.33	.55	.80	.73	.72-.73	.35-.36	.27-.28	.23	.24
Kentucky and Indiana (Unwashed) :											
3/8 blood	.53	.50-.51	.27-.28	.42	.63	.79	.80	.44-.45	.37-.38	.27	.27 1/2
1/4 blood	.50	.47-.48	.25-.26	.40	.62	.78	.80	.43-.44	.37-.38	.25	.26
Braid	.34	.36-.37	.15-.17	.28	.35	.68	.67-.68	.36-.37	.33-.34	.22	.23

TABLE N—Continued

Missouri, Iowa and Illinois (Unwashed) :		1923	1922	1921	1920	1919	1918	1917	1916	1915	1914	1913
.46	.48	.24-.25	.38	.60	.76	.72	.40-.42	.35-.36	.25 1/2-.26	.22-.23		
.45	.43	.23-.24	.36	.60	.75	.72	.39-.40	.35-.36	.25	.26	.22-.23	
.32	.32	.15-.16	.28	.35	.67	.67-.68	.36-.37	.31-.32	.21	.22	.22-.23	
Texas (Scoured basis) :												
12 months, fine and fine medium . . .	1.20	1.30	.65-.75	1.00	1.80	1.75	1.70	.80-.85	.67-.68	.56	.58	.50-.52
Spring, fine and fine medium . . . .	1.15	1.20	.55-.60	.85	1.60	1.60	1.50	.70-.75	.60-.62	*	*	
Fall, fine and fine medium . . . .	1.00	1.10	.50-.55	.65	1.50	1.48	.57-.58	.55-.57	.45	.47	.42-.43	
California (Scoured basis) :												
12 months, fine . . . . .	1.15	1.05-1.10	.70-.75	.90	1.80	1.75	1.68	.80-.85	.65-.67	*	*	
Spring, fine . . . . .	1.10	.95-1.10	.55-.60	.75	1.60	1.60	1.50	.65-.70	.60-.62	*	*	
Fall, fine . . . . .	.90	.90-.95	.50-.55	.50	1.30	1.47	1.45	.60-.62	.54-.56	*	*	
Territory Wool—Montana, Wyoming, Utah, Idaho, Oregon, etc. (Scoured basis) :												
Staple, fine and fine medium . . . . .	1.30	.80-.85	1.20	2.00	1.85	1.80	.88-.90	.70-.72	.58	.60	.52-.54	
Clothing, fine and fine medium . . . .	1.15	.60-.65	1.00	1.85	†	1.65	.83-.85	.67-.68	.54	.55	.47-.49	
1/2 blood . . . . .	1.10	.68-.72	.90	1.70	1.78	1.68	*	.68-.69	*	*	*	
3/8 blood . . . . .	1.00	.50-.55	.75	1.35	1.55	1.42	*	.66-.67	*	*	*	
1/4 blood . . . . .	.85	.80-.84	.55	1.15	1.40	1.28	*	.62-.64	*	*	*	
New Mexico (Scoured basis) :												
No. 1 . . . . .	1.20	1.20-1.25	.65-.70	.95	1.56	1.65	1.70	.78-.80	.64-.66	.54	.55	.47-.48
No. 2 . . . . .	.90	1.10	.55-.58	.75	1.40	1.55	1.58	.63-.65	.58-.60	.46	.48	.42-.43
No. 3 . . . . .	.75	.80-.85	.38-.40	.40	1.10	1.35	1.38	.58-.60	.53-.55	.38	.40	.37-.38
Georgia and Southern (Unwashed) . . .	.48	.43-.45	.19-.21	.25	.58-.64	.68-.70	.70-.71	.37-.38	.33-.34	.24	.25	.22-.23

† But little in the market.

\* Grade not quoted.

TABLE O

## PRODUCTION OF RAW WOOL IN PRINCIPAL WOOL PRODUCING COUNTRIES, 1923.

United States .....	266,110,000	Union of South Africa....	176,000,000
Australia .....	600,931,156	Continent of Europe	
New Zealand .....	214,705,920	(Fleece washed) .....	514,825,485
Argentina .....	297,000,000	United Kingdom	
Uruguay .....	92,000,000	(Fleece washed) .....	102,300,000

TABLE P

## NUMBER OF SHEEP IN THE WORLD ACCORDING TO THE LATEST AVAILABLE REPORTS AND ESTIMATES, 1923

FROM NATIONAL ASSOCIATION WOOL MANUFACTURERS' ANNUAL WOOL REVIEW

Country	Year	Number of Sheep
<b>NORTH AMERICA:</b>		
United States, Continental.....	1923	38,347,000*
Noncontiguous, except Philippine Islands....		
Hawaii .....	1920	44,000
Porto Rico .....	.....	4,000
Alaska .....	.....	200
Total United States .....	.....	38,395,200
Canada .....	1923	2,755,273*
Newfoundland .....	.....	98,000*
Total North America .....	.....	41,248,473
<b>CENTRAL AMERICA AND WEST INDIES:</b>		
Mexico .....	1922	500,000
Guatemala .....	.....	383,000
Other Central America .....	.....	124,000
Cuba .....	1921	30,000
British West Indies .....	.....	28,000
Dutch West Indies .....	.....	22,600
Other West Indies .....	.....	20,000
Total Central America and West Indies .....	.....	1,107,600
<b>SOUTH AMERICA:</b>		
Argentina .....	1923	35,267,591
Brazil .....	1923	7,933,437
Bolivia .....	1913	b 1,750,000*
Chile .....	1923	4,800,000
Columbia .....	1917	246,000
Ecuador .....	1921	180,000
Uruguay .....	1919	11,473,000
Paraguay .....	.....	600,000
Peru .....	1917	a 6,357,000
Venezuela .....	1921	62,800**
Falkland Islands .....	.....	667,389
Other South America .....	.....	300,000
Total South America .....	.....	69,637,217
<b>EUROPE:</b>		
Austria .....	1922	597,414**
Belgium .....	1921	125,000
Bulgaria .....	1922	10,000,000
Czechoslovakia .....	1920	986,611**
Denmark (d), Iceland and Faroe Islands .....	1921	c 1,169,328**

Country	Year	Number of Sheep
<b>EUROPE—Continued:</b>		
Estonia	1922	744,937
Finland	1922	a 1,570,985**
France	1922	9,782,420
Germany	1922	5,566,086
Greece	1921	a 5,547,000**
Hungary	1923	a 2,800,000
Italy	1918	11,753,910
Latvia	1923	1,461,000
Lithuania	.....	1,161,500
Netherlands	1921	668,211
Norway	1918	1,207,923**
Poland—exclusive of Vilno and Upper Silesia	1921	2,178,216**
Portugal (Continental)	1920	3,850,733*
Roumania	1922	12,164,405*
Russia	1920	36,065,000
Spain	.....	20,600,000
Sweden	1919	1,563,654
Switzerland	1921	a 244,435
United Kingdom	1923	24,196,448††
Yugoslavia	1921	a 7,542,110
All other Europe	.....	20,000
Total Europe	.....	163,567,326
<b>ASIA:</b>		
British India	.....	22,084,579
Ceylon	.....	57,200
China	1921	e 45,000,000**
Cyprus	1922	280,747
Japan	1922	12,046
Philippine Islands	1916	130,000**
Russia in Asia	1921	10,499,000
Turkey in Asia	1913	27,094,678
Other Asia	.....	1,240,000
Total Asia	.....	106,398,250
<b>AFRICA:</b>		
Algeria	1922	8,941,000
Basutoland	1920	1,854,426
British Southwest Africa (formerly German)	1922	1,350,000
British Tanganyika Territory (formerly German East Africa)	1921	3,405,103
Egypt	1922	941,700
French Equatorial Africa	1918	1,000,000
French West Africa	.....	5,863,971
Italian Somaliland	1920	1,666,308
Kenya (British East Africa)	1922	2,463,715
Madagascar	1921	110,000
Morocco	1922	7,264,000
Nigeria	1921	1,909,000
Rhodesia	1922	316,811
Soudan (Anglo-Egyptian)	1909	830,000
Tunis	1922	2,820,000
Uganda Protectorate	1920	266,920
Cape of Good Hope	.....	
Natal	Union of	
Orange Free State	South Africa	30,052,705**†
Transvaal	.....	
All other Africa	.....	1,500,000
Total Africa	.....	72,555,659

Country	Year	Number of Sheep
OCEANIA:		
Australia .....	1922	80,209,951
New Zealand .....		22,928,864
Total Australasia .....		103,138,815
Other Oceania .....		10,000
Total Oceania .....		103,148,815
Total World .....		557,663,340

a Includes lambs.

b Includes goats.

c Iceland and Faroe Islands, years 1920 and 1919, respectively.

d Does not include sheep and lambs in North Slesvig.

e Includes Thibet, Mongolia and China-Turkestan.

\* Official estimates from the countries covered.

\*\* Official census or other official reports from the countries covered.

All figures without asterisk are estimates based on best information obtainable.

† Includes only wooled sheep and Angora goats. Wool estimate does not include 16,000,000 pounds of mohair grown.

†† Figures for Irish Free State estimated, official figures not being available.

TABLE Q

## DISTRIBUTION OF SHEEP AT CLOSE OF YEAR IN AUSTRALIA, 1923

	Number of Sheep	Pounds of Wool Exported 1922-1923
New South Wales .....	37,177,402	294,200,000
Victoria .....	11,765,520	95,718,000
Queensland .....	17,051,756	111,602,100
South Australia .....	6,000,000	51,198,000
West Australia .....	6,664,000	38,721,056
Tasmania .....	1,551,273	9,472,000
	80,209,951	600,931,156
New Zealand .....	22,928,864	214,705,920
Combined total .....	103,138,815	815,637,076

TABLE R

## NUMBER OF WOOLED SHEEP IN SOUTH AFRICA AT CLOSE OF YEAR 1923

Cape .....	}	Union of South Africa	30,052,705
Transvaal .....			
Orange Free State .....			
Natal .....			

TABLE S

ESTIMATED NUMBER OF SHEEP AND LAMBS IN CANADA BY PROVINCES, 1922-1923

Provinces	Sheep		Lambs		Total 1923	Total 1922
	1923	1922	1923	1922		
P. Edward Island..	46,781	59,244	37,152	46,459	83,933	105,703
Nova Scotia.....	140,479	185,987	118,058	143,358	258,537	329,345
New Brunswick....	87,441	127,886	70,367	108,145	157,808	236,031
Quebec .....	463,538	567,095	359,459	423,823	822,997	990,918
Ontario .....	464,549	501,319	443,124	485,298	907,673	986,617
Manitoba .....	51,010	61,539	42,152	51,324	93,162	112,863
Saskatchewan .....	79,483	127,598	57,757	64,339	137,240	191,937
Alberta .....	143,517	166,012	95,657	94,364	239,174	260,376
Br. Columbia.....	28,530	28,171	24,806	21,574	53,336	49,745
Indian Reserves (a)	780	b	633	b	1,413	b
Total .....	1,506,108	1,824,851	1,249,165	1,438,684	2,755,273	3,263,535

a Included for the first time.

b Not available.

TABLE T

ESTIMATED NUMBER OF SHEEP AND THE PRODUCTION AND VALUE OF  
CANADIAN WOOL CLIP, 1915-1923

Year	Sheep	Production	Average Price Per Lb.	Value
			Pounds	
1915.....	2,038,662	12,000,000	28	\$3,360,000
1916.....	2,022,941	12,000,000	37	4,440,000
1917.....	2,369,358	12,000,000	59	7,000,000
1918.....	3,052,748	20,000,000	60	12,000,000
1919.....	3,421,958	20,000,000	60	12,000,000
1920.....	3,720,783	24,000,000	22	5,280,000
1921.....	3,675,860	21,251,000	14	2,975,000
1922.....	3,262,626	18,523,392	15	3,149,000
1923.....	2,755,273	15,539,416	23	3,574,000*

\* Provisional estimate.



FIG. 85.—Sheep Dipping at Jondaryan, West Queensland, Australia.  
*Reproduced by permission of The Philadelphia Commercial Museum*

## MISCELLANEOUS

SCORE CARD FOR SHEEP

As Adopted by the Illinois Agricultural College

Weight, pounds .....	4
Weight, score according to age and breed .....	4
Form, straight top and underline; deep broad, low set, compact, symmetrical .....	10
Quality, hair fine; bone fine but strong; even covering of firm flesh; features refined but not delicate; stylish .....	10
Constitution, chest capacious; brisket well developed; flanks deep; bone strong; movement bold and vigorous .....	10
Condition, thrifty; skin pink; fleece elastic; well fleshed, but not excessively fat; deep covering of firm flesh .....	5
Disposition, quiet, but not sluggish .....	2
Color and markings, according to breed .....	2
Muzzle, mouth and nostrils large; lips thin .....	1
Eyes, full, bright, clear .....	1
Face, short, according to breed .....	1
Forehead, broad, full .....	1
Ears, texture fine; size and form, according to breed .....	1
Neck, thick, short, neatly tapering to head; throat clean, according to breed .....	1
Shoulder vein, full .....	1
Shoulder, covered with flesh; compact; smoothly joined with neck and body .....	3
Brisket, well developed; breast wide .....	1
Legs, straight, short, set well apart; pasterns upright; feet squarely (fore), placed neither close nor sprawling .....	2
Ribs, long, well sprung, thickly fleshed .....	3
Back, broad, straight, thickly and evenly fleshed .....	5
Loin, thick, broad, firm .....	5
Flank, full, even with underline .....	1
Hips, level, smoothly covered; width in proportion with other part .....	1
Rump, long, level, wide and even in width; not covered at tailhead with excessive fat .....	3
Thighs full, fleshed well down to hock .....	2
Twist, deep, plump, firm, indicating fleshiness .....	5
Legs, straight, short, set well apart, bones smooth strong, being neither (hind) coarse nor fine; pasterns upright; feet squarely placed; neither close nor sprawling .....	3
Wool, quantity, long, dense, even, according to breed .....	5
Wool, quality, structure and color true; fine, soft, even, according to breed .....	5
Wool, condition, strong, bright, clean, slight amount of yolk .....	4
 Total (perfect score) .....	100

## SCORE CARD FOR MUTTON SHEEP

Adopted by Department of Animal Husbandry, the University of Wisconsin

Age ..... Teeth .....

GENERAL APPEARANCE—24 points:	Possible Score
Weight, estimated; actual pounds according to age .....	6
Form, low, long, symmetrical, compact and evenly covered with firm flesh .....	10
Quality, clean bone; silky hair .....	6
Temperament .....	2

## HEAD AND NECK—9 points:

Muzzle, fair size; nostrils large; lips thin; mouth large .....	2
Eyes, full, bright .....	1
Face, short, bold expression .....	1
Forehead, broad .....	1
Ears, fine, erect .....	1
Neck, thick, short; throat clean .....	3

## FOREQUARTERS—13 points:

Shoulder vein, full .....	2
Shoulders, covered, compact .....	3
Chest, deep, wide, large girth .....	3
Brisket, full, prominent; breast wide .....	2
Legs, straight, short, wide apart, strong; forearm full, shank smooth .....	3

## BODY—13 points:

Back, straight, wide .....	4
Loin, broad, thick .....	4
Ribs, deep, arched .....	3
Flank, low, thick, making underline straight .....	2

## HINDQUARTERS—17 points:

Hips, smooth, far apart .....	3
Rump, long, level, wide .....	4
Thighs, full, well fleshed .....	3
Twist, plump, deep .....	4
Legs, straight, short, strong; shank smooth .....	3

## CONSTITUTION—10 points:

Girth large .....	3
Skin, pink color .....	3
Fleece, dense and even over body, yolk abundant .....	4

## WOOL—14 points:

Quantity, long, dense, even .....	6
Quality, fine, soft, pure, even .....	4
Condition bright, strong, clean .....	4

Total ..... 100

DIRECTIONS FOR CARING FOR SHEEP IN ORDER TO PRODUCE  
A GOOD QUALITY AND CONDITION OF WOOL  
(Canadian Live Stock Branch)

1. Feed sheep well and regularly. Sheep poorly fed will possess a harsh fleece lacking in oil and frequently with a feeble or weak fibre. This does not constitute desirable wool for sale. Where sheep are starved for a period the effects will be shown in the wool by a weak section which will break readily and consequently cannot be used satisfactorily for combing or worsted purposes.
2. Every effort should be taken to keep the wool free from chaff, hay and burrs. This can be avoided by using proper feed racks and care in preventing hay or straw dropping upon the sheep during feeding.
3. If sheep are scouring, if possible keep the wool well clipped behind, so as to prevent the formation of heavy dung locks.
4. Endeavor to eliminate in breeding operations black sheep from the flock. Mate only sheep possessing pure white wool. Black wool is sold in the reject class.
5. In marking sheep, never use oil paint or tar, which are insoluble and will not scour from the wool.
6. Sheep should be dipped in some reliable material twice a year, in the fall before entering winter quarters and in the spring after shearing.

AN OLD SHEPHERD'S DON'TS  
(Canadian Live Stock Branch)

1. Don't use a "scrub" ram.
2. Don't forget to trim the ram's feet once in six or eight weeks and the ewes' feet at least three times a year. The wool on the ewes' rump requires trimming also.
3. Don't overwork any ram, particularly a ram lamb. Confine the size of the flock in accordance with the age and vigor of the ram. A mature ram should be restricted to 50 ewes; a ram lamb, 30.
4. Don't allow the ram to remain with the pregnant ewes during the winter.
5. Don't overfeed or underfeed at any time. In order to gain the highest profits, thrift must be maintained in the flock.
6. Don't feed, except very sparingly, mangels or sugar-beets to rams. Calculi or stones may be formed in the urinary organs which may become, at times, large enough to block completely the urethral canal and cause the bladder to burst, with consequent death.
7. Don't forget to cull the ewe flock before each mating season. A few good ewes well-mated are more satisfactory and profitable than a large number of indifferent ones. "Every ewe has her day."
8. Don't forget to sow your rape patch for flushing the ewes. The ewes require and deserve a vacation after raising lambs. It pays for itself in the next lamb crop.

9. Don't think you can remember each ewe's record. Have ear-marks and be certain.

10. Don't expect to fix a type by constantly changing the ram. Decide on the type which is best suited to your purpose and sustain it through thick and thin.

11. Don't forget to dip all sheep at least once a year. Newly purchased animals may be the carriers of disease. Dissemination can be prevented by quarantine and dipping.



FIG. 86.—Culls.

DIRECTIONS FOR PREPARING AND PACKING WOOL  
(Canadian Live Stock Branch)

1. Shearing should be done on a clean board floor, never on the dirt, and the fleece should be kept as compact as possible.

2. Fleeces should be tied with paper twine, never binder or sisal twine. Turn in the sides of the fleece and roll compactly from tail to neck with the bright or clipped surface outward.

3. The wool should be packed in very closely woven jute, hemp or paper-lined sacks.

4. Tags, dung locks or stained pieces should never be included with the fleeces, but always packed separately if wool is adhering to them.

5. All black or gray fleeces should be packed by themselves.

6. Lamb fleeces possessing unusual quality and length may well be kept apart from the others and offered for sale as a distinct class.

7. The wool should be absolutely dry at shearing and should never, subsequently, be permitted to become wet.

8. Tubwashing should not be practiced. If washing is followed at all, let it be done on the sheep's back, and at the time of shearing keep the washed separate from the unwashed.



FIG. 87.—Scrub Ram.

TYPICAL MARKET QUOTATIONS

(107) WOOL

(June, 1924)

OHIO, PENNSYLVANIA AND WEST VIRGINIA (Unwashed)

Fine .....	.44	$\frac{3}{8}$ blood .....	.44
Fine Delaine .....	.50	$\frac{1}{4}$ blood .....	.42
$\frac{1}{2}$ blood .....	.50		

MICHIGAN, NEW YORK AND WISCONSIN (Unwashed)

Fine .....	.42	$\frac{3}{8}$ blood .....	.44
Fine Delaine .....	.48	$\frac{1}{4}$ blood .....	.40
$\frac{1}{2}$ blood .....	.48		

MISSOURI, IOWA AND ILLINOIS (Unwashed)

$\frac{3}{8}$ blood .....	.45	Braid .....	.40
$\frac{1}{4}$ blood .....	.41		

## KENTUCKY AND INDIANA (Unwashed)

$\frac{1}{2}$ blood .....	.49	$\frac{1}{4}$ blood .....	.45
$\frac{3}{8}$ blood .....	.48	Braid .....	.40

## TEXAS (Scoured Basis)

12 mos., fine and fine medium..	1.30	Fall, fine and fine medium.....	1.05
Spring, fine and fine medium...	1.17		

## CALIFORNIA (Scoured Basis)

Northern, 12 mos. ....	1.35	Fall free .....	1.08
Spring Middle Counties .....	1.18	Fall defects .....	1.03
Southern, 12 mos. ....	1.13	Carbonized .....	1.15

## MONTANA, WYOMING AND IDAHO (Scoured Basis)

Staple, fine and fine medium...	1.30	$\frac{3}{8}$ blood .....	.95
Clothing, fine and fine medium..	1.15	$\frac{1}{4}$ blood .....	.85
$\frac{1}{2}$ blood .....	1.15		

## NEW MEXICO AND COLORADO (Scoured Basis)

No. 1 .....	1.25	No. 3 .....	.80
No. 2 .....	1.10		

## NEVADA, UTAH AND ARIZONA (Scoured Basis)

Staple, fine and fine medium....	1.30	$\frac{3}{8}$ blood .....	.95
Clothing, fine and fine medium..	1.15	$\frac{1}{4}$ blood .....	.85
$\frac{1}{2}$ blood .....	1.15		

## GEORGIA AND SOUTHERN STATES

(Unwashed) .....	.48
------------------	-----

## DAKOTAS AND MINNESOTA (Scoured Basis)

Staple, fine and fine medium....	1.30	$\frac{3}{8}$ blood .....	.95
Clothing, fine and fine medium..	1.15	$\frac{1}{4}$ blood .....	.85
$\frac{1}{2}$ blood .....	1.15		

## OREGON (Scoured Basis)

Staple, fine and fine medium....	1.30	$\frac{3}{8}$ blood .....	.95
Clothing, fine and fine medium..	1.15	$\frac{1}{4}$ blood .....	.85
$\frac{1}{2}$ blood .....	1.15		

## PULLED WOOLS (Eastern Scoured Basis)

Fine A .....	1.28	Fine combings .....	1.10
A Super .....	1.13	Medium combing .....	.97
B Super .....	1.00	Low combing .....	.88
C Super .....	.80		

The following table shows a typical market report and the price of English wools when the European War commenced, and the value of the same descriptions ten years later. The prices have all been changed from pence to cents.

Description	June, 1914	June, 1924	Cents per Lb.	Description	June, 1914	June, 1924	Cents per Lb.
Southdown tegs and ewes.	.31	.59		Irish hogs, pick and super	.28 1/2	.45	
Pick Shropshire hogs and wethers	.30	.57		Irish wethers, pick and super	.28 1/2	.43	
Wiltshire Down tegs and ewes	.30 1/2	.57		Best Kent tegs	.27 1/2	.44	
Hampshire Down tegs and ewes	.30	.55		Lonk ewes and wethers	.23	.28	
Dorset Down tegs and ewes	.30 1/2	.58		Welsh fleeces, selected	.24 1/2	.33	
Oxford Down tegs and ewes	.29	.49		Radnors, pick and fine	.24	.38	
Cheviot hogs, super	.28	.51		Radnors, deep	.23	.31	
Cheviot wethers, super	.26	.49		Herdwick ewes and wethers	.17	.25	
Half-bred hogs (Mid Counties)	.26 1/2	.43		Black-faced hogs	.18	.25	
Half-bred wethers (Mid Counties)	.26	.42		Black-faced ewes and wethers	.17 1/2	.25	
Norfolk half-bred hogs	.27	.43		Half-bred, super, 56's	.30 1/2	.62	
Norfolk half-bred wethers	.26	.42		Half-bred, super, 50's	.27 1/2	.50	
Lincoln hogs	.24 1/2	.36		Cross-bred, medium, 46's	.24	.37	
Lincoln wethers	.24	.35		Cross-bred, coarse, 40's	.22	.36	
Leicester hogs	.25	.37		Sliped half-bred lambs	.35 1/2	.67	
Leicester wethers	.24 1/2	.36		Sliped three-quarter-bred lambs	.30	.58	
Devon greasy	.20	.31		Sliped Leicester lambs	.27 1/2	.49	
				Sliped Lincoln lambs	.26 1/2	.44	

#### FOREIGN CLOTHING AND COMBING

Australia (Scoured Basis)			Montevideo (Greasy)		
Victorian combing:			Montevideo (Greasy):		
70s	1.15	@ 1.17	Lincoln	.44	@ .46
64s	1.00	@ 1.05	1/4 blood	.41	@ .43
60s	.85	@ .88	High	.43	@ .45
Sydney combing:			3/8 blood	.47	@ .50
70s	1.11	@ 1.15	1/2 blood	.50	@ .52
64s	.96	@ 1.01	Merino	.54	@ .58
60s	.81	@ .83	Buenos Aires, X-breds:		
New Zealand, X-breds:			Lincoln	.35	@ .37
36 to 40s	.31	@ .33	1/4 blood	.37	@ .39
40 to 44s	.33	@ .35	High	.46	@ .48
46s	.37	@ .39			

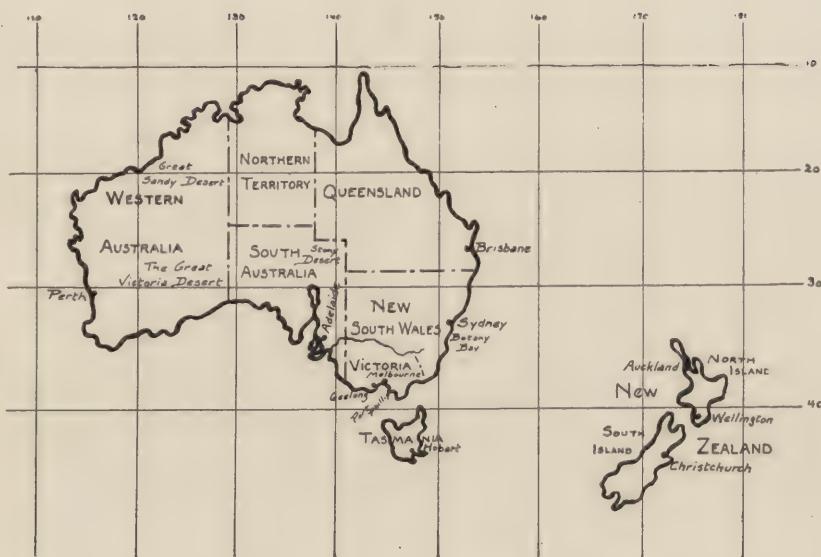


FIG. 88.—Map of Australia and New Zealand.

## (139) MOHAIR

(October, 1922)

## FOREIGN

Turkey:	Description	Price Per Pound	Cape:	Description	Price Per Pound
Fine districts	.....	.44		Summer kids	.88
Fair average	.....	.33		Winter kids	.72
Good, yellow fleece	.....	.31		Firsts	.33
Ordinary	.....	.29		Seconds	.30
Inferior	.....	.20		Winter	.31
Good gray	.....	.23		Mixed	.31
Loeks	.....	.16		Thirds	.20

The above prices are in bond.

## DOMESTIC

Best combing	.....	.75	Best carding	.....	.60
Good combing	.....	.45	Good carding	.....	.38
Ordinary combing	.....	.40	Ordinary carding	.....	.20

## MOHAIR PRODUCTION

Mohair Produced in United States, 1900 to 1923, from the United States Census and Best Available Sources

Year	Weight of Mohair	Year	Weight of Mohair
1900	961,328	1917	6,000,000
1910	3,778,706	1918	6,000,000
1912	4,000,000*	1919	8,000,000
1913	4,500,000	1920	7,000,000
1914	4,500,000	1921	7,000,000
1915	6,000,000	1922	7,750,000
1916	6,000,000	1923	8,000,000

\* Figures from 1912-1923, inclusive, are commercial estimates.

## TYPICAL MARKET QUOTATIONS ON NOILS, WASTES, CLIPS, RAGS AND RE-WORKED WOOL

(May, 1923)

## (158) NOILS

Fine white noils.....	.92	@ .95	Mohair noils, No. 1, second combing .....	.90	@ 1.10
½ blood white noils...	.88	@ .92	Alpaca noils, first combing .....	.55	@ .75
¾ blood white noils...	.85	@ .93	Alpaca noils, second combing (recombed)..	.90	@ 1.10
High ¼ blood white noils .....	.73	@ .75	Camel hair noils.....		
Recombed white ¼ blood noils .....	.75	@ .80	Short nubby silk noils.	.20	@ .24
Fine colored noils, re- combed .....	.75	@ .78	Long staple silk defec- tive noils .....	.35	@ .40
½ blood colored noils.	.60	@ .64	Foreign good white clear long staple silk noils .....	.42	@ .47
¾ blood colored noils.	.53	@ .57	Foreign good white clear fair staple silk noils .....	.32	@ .36
¼ blood colored noils.	.48	@ .52	Tussah silk noils, long staple .....	.35	@ .40
Fine carbonized noils..	1.00	@ 1.06			
Medium carbonized noils .....	.88	@ .92			
¼ blood carbonized noils .....	.78	@ .82			
Mohair noils, first combing, best .....	.76	@ .80			

## (160) SOFT WASTES

Fine white Australian lap waste .....	1.35	@ 1.40	Fine white card waste, dusted .....	.60
Fine white lap waste..	1.30	@ 1.35	Medium white card waste, dusted .....	.48
Fine colored lap waste..	1.10	@ 1.15	Colored card waste, fine, clean .....	.22
Medium colored lap waste .....	.65	@ .70	Colored card waste, medium .....	.12 @ .15
Fine white Australian ring waste .....	1.20	@ 1.25		
Fine white ring waste.	1.20	@ 1.25		
Australian white card waste, dusted .....	.58	@ .62		

## (162) GARNETTED YARN WASTE

Free fine colored thread worsted .....	.54	@ .58	Fine colored thread waste .....	.35	@ .40
½ blood white thread worsted .....	.85	@ .92	Medium colored thread waste .....	.26	@ .30
¼ blood white thread worsted .....	.75	@ .80	White spinners' waste, greasy .....		.30
Fine white Australian thread waste .....	1.05	@ 1.12	Colored spinners' waste, greasy .....		.22
Fine white thread waste .....	1.00	@ 1.07	Colored carpet yarn waste .....	.25	@ .30
White carpet thread waste .....	.38	@ .42	Low carpet yarn waste.	.22	@ .26

## (167) RAGS

(May, 1923)

## NEW WOOLEN RAGS

Fine worsted clips ...	.13	@ .16	Foreign clothing clips.	.14	@ .15
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## MEN'S WEAR CLIPS

## Worstseds:

Dark .....	.17	@ .18	Brown .....	.25	@ .30
Fine dark .....	.15	@ .16	Blue .....	.25	@ .30
Light .....	.21	@ .22	Black .....	.30	@ .32
Black and white....	.25	@ .26	Edges .....	.18	@ .20

## LADIES' WEAR CLIPS

## Worstseds and Serges:

White .....	.54	@ .56	Maroon .....	.30	@ .32
Blue .....	.26	@ .28	Light .....	.20	@ .22
Black .....	.27	@ .28	Tan .....	.34	@ .36
Brown .....	.32	@ .33	Light blue .....	.28	@ .30
Old green .....	.09		Mixed dark .....	.10	@ .12

## FLANNELS

Blue .....	.13	@ .14	Tan .....	.26	@ .27
Black .....	.10	@ .11	Mixed .....	.09	@ .10
Green .....	.14	@ .15	Scarlet .....	.34	@ .35
Light French .....	.24	@ .25			

## CLOTH

Fine black and white..	.20	@ .22	Fine light .....	.18	@ .20
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## HEAVY CLIPS

Mixed Mackinaws ...	.06	@ .07	Oxfords .....	.10	@ .12
Mixed overcoatings ..	.04	@ .05	Black and white .....	.14	@ .16
Brown chinchillas and and cheviots .....	.08	@ .09	Mixed lights .....	.09	@ .10
Blue chinchillas and cheviots .....	.09	@ .10	White chinchillas .....	.16	@ .18
Black chinchillas and cheviots .....	.10	@ .12	Brown lights .....	.10	@ .12
			Shawls .....	.08	@ .10

## COTTON WARP CLIPS

Serges, black and white	.13	Black cloakings .....	.10
Serges, light .....	.12	Blue cloakings .....	.10
Palm Beach .....	.12	Brown cloakings.....	.10
Delaines, mixed colored	.08	Mixed cloakings .....	.07
Black astrakhans ....	.10	Dark unions .....	.04 1/2 @ .05
Mixed astrakhans ....	.10	Light unions .....	.05 @ .05 1/2

## GOVERNMENT CLIPS

Indigo .....	.30	@ .32	Cadets .....	.30	@ .32
Khaki .....	.34	@ .36			

## OLD WOOLEN RAGS

## Merinos:

Fine light .....	.20	@ .21
Coarse light .....	.07	@ .08
Fine dark .....	.06	@ .06 1/2
Coarse dark .....	.03	@ .03 1/2
Fine black .....	.14	@ .15

## Serges:

Light .....	.14	@ .15
Brown .....	.15	@ .16
Blue .....	.07	@ .07 1/2
Black .....	.06	@ .06 1/2
Red .....	.14	@ .15
Green .....	.11	@ .12

## Flannels:

Fine white .....	.35
Coarse white .....	.32
White No. 2 .....	.25
Red .....	.17
Blue .....	.05 1/2

## Knit:

White .....	.35	@ .36
Blue, dark .....	.17	@ .18
Blue, light .....	.14	@ .16
Blue, mixed .....	.15	@ .16
Black, trimmed ....	.16	@ .17
Black, untrimmed ..	.14	@ .15
Red .....	.23	@ .24
Brown .....	.19	@ .20
Light .....	.22	@ .23
Steel gray .....	.19	@ .20
Dark .....	.15	@ .16
Fancy .....	.09	@ .10

## Hoods:

Light .....	.24	@ .25
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## Delaines:

Skirted .....	.04	@ .05
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## Linseys:

Red flannel .....	.04 1/2
Best plaids .....	.04 1/2
Best brown .....	.04 1/2
Best blue .....	.04 1/2
Common gray .....	.02 @ .03
Light yarn, extra fine...	.30 @ .35
Light yarn, worsted....	.38 @ .40
Dark mixed, extra fine and free from cotton and silk .....	.20 @ .23
Dark mixed, No. 2.....	.16 @ .18
Medium to coarse grades, all wool yarn .....	.19 @ .22
Red flannel, all wool ...	.20 @ .22
Red knit stock, strictly all wool .....	.28 @ .30
No. 1 dark blue for hosiery, strictly all wool	.18 @ .19
No. 2, same, not all wool.	.12 @ .14
Fine dark merino, all wool, No. 1 .....	.07
Medium dark merino, all wool, No. 2 .....	.05
Medium dark merino, not extracted .....	.03
Medium dark merino, all wool .....	.05
Fine light merino, all wool .....	.11 @ .13
Fine black merino, all wool .....	.14 @ .17
Medium light merino, all wool .....	.15 @ .18
Medium light merinos, extracted .....	.10 @ .12
Medium black .....	.10 @ .12
To order: Olives, all wool, fine .....	.13 @ .15
Blues, all wool .....	.13 @ .15

## SKIRTED CLOTHS

## Skirted worsteds:

Light .....	.07	@ .07½
Black .....	.06	@ .06½
Blue .....	.05½	@ .06
Dark .....	.04	@ .04½
Brown .....	.07	@ .07½

## Skirted cloth:

Fine light .....	.05	@ .05½
Light .....	.04½	@ .05
Blue .....	.03	@ .03½
Plain black .....	.03	@ .03½
Dark .....	.02½	@ .03
Skirted, tan kersey ..	.15	@ .16
Skirted, tan covert ..	.18	@ .20

## (168) SHODDY, MUNGO AND EXTRACT WOOL

White softs, "mixed," all wool .....	.56	@ .60
White softs, all wool....	.62	@ .64
Coarse light merinos, all wool .....	.21	@ .22
Fine light merinos, all wool .....	.36	@ .37
Coarse dark merinos, all wool .....	.12	
Dark worsteds, all wool. .16		@ .18
Black worsteds, all wool. .23		@ .24
New black worsteds, fine. .43		@ .44
Light worsteds, all wool. .22		@ .25

New blue worsteds, fine. .42		@ .44
New light worsteds, fine. .29		@ .32
Fine white worsteds, gar- netteds .....	.50	@ .55
¼ blood white worsted garnetteds .....	.60	@ .65
⅓ blood white worsted garnetteds .....	.53	@ .55
½ blood white worsted garnetteds .....	.55	@ .60
Colored garnetteds .....	.56	@ .58
Fine Oxford garnetteds..	.58	@ .60

## FLOCKS

Fulling flocks, white....	.09	@ .10	Blanket flocks, good straight white .....	.05	@ .06
Fulling flocks, colored ..	.06	@ .07	Shear flocks .....	.01	@ .02
Napper flocks, white ....	.08	@ .10			
Napper flocks, colored ..	.05	@ .06			

IMPORTS OF NOILS, WASTES, WOOL RAGS, FLOCKS AND MUNGO BY MONTHS,  
FISCAL YEAR ENDED JUNE 30, 1923

Fiscal Year July 1-June 30, 1922-1923	Noils		Wastes (a)		Wool Rags, Flocks and Mungo	
	Quantity	Value	Quantity	Value	Quantity	Value
	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars
July 1 to Sept. 1, 1922† .....	222,585	143,437	.....	.....	17,851,682	2,277,570
October* .....	1,517,438	710,050	1,321,447	570,935	1,507,842	233,375
November .....	2,375,091	1,187,061	478,271	232,807	450,541	104,492
December .....	2,127,466	1,132,723	1,047,650	519,845	507,926	168,160
January .....	1,157,559	572,680	1,129,430	522,344	984,469	251,474
February .....	947,733	535,464	823,763	427,800	921,193	228,779
March .....	1,885,469	1,047,295	1,250,333	656,381	2,396,761	620,386
April .....	1,115,769	699,135	1,138,650	580,022	1,875,652	485,785
May .....	915,398	694,473	631,368	324,616	963,810	253,390
June .....	433,893	333,986	523,423	280,443	555,433	174,792
Total .....	12,698,401	7,056,304	8,344,335	4,115,193	28,015,309	4,798,203

a Wastes not reported separately prior to October.

† Not possible to give monthly totals.

\* September 22 to October 31.

## GLOSSARY OF TERMS USED

**ADELAIDE WOOLS.**—Most of the wools from the State of South Australia are sold in Adelaide, and are known as Adelaide wools.

**ANTHRAX.**—Both men and animals are subject to this infectious disease, which develops a virulent ulcer and high fever. It localizes in the skin or lungs and sometimes in the intestines. It is not always fatal. When confined to the skin alone a cure is usually effected. This disease is also known as black-leg and wool-sorters' disease.

**ASTRAKHAN.**—(a) This name is given to a grade of Karakul lambskins. The astrakhans are less lustrous, have longer hair and a much more open curl than the first grade of Karakul lambskins, which are known as Persian lamb. The name is taken from a province of that name bordering on the Caspian Sea, in the southeastern part of European Russia. (b) The name is also applied to woven and knitted imitations of natural astrakhan. Mohair and luster wool yarns are used to give the luster.

**BABY COMBING WOOL.**—Short, fine staple wools usually under 2.5 inches, and treated by the French comb in the manufacture of French-spun worsted yarns.

**BELLY WOOL.**—That which grows on the belly of the sheep. It is often uneven and tender, and is always shorter than wool from other parts of the body. It is often stained and dungy.

**BLACK TOPPED.**—This term describes the effect produced by Merino fleeces containing a large amount of yolk which collects and holds dirt and dust.

**BLACK WOOL.**—The term includes any wool that is partially or wholly black, brown or gray.

**BOTANY WOOL.**—All fine Australian wools are better known in Great Britain as Botany wools, and the term is used extensively in the United States. The name is taken from the harbor called Botany Bay, which is located on the eastern coast of

Australia, south of Sydney, in the State of New South Wales. The district adjacent to this bay is noted for the production of fine wools.

**BRADFORD SYSTEM.**—This is also known as the English System. It is one of the methods of producing worsted yarns. The spinning is performed on cap frames. The thread is smooth compared with woolen yarn and the fibers parallel.

**BRAID WOOL.**—Grade name. Also known as luster wool.

**BREAK IN WOOL.**—Wool which is weak at one particular point of the staple, but sound above and below the break.

**BRIGHTNESS.**—Wool of light appearance.

**BRITCH WOOL.**—Wool from the hindquarters of the sheep; usually the coarsest on the body.

**BROAD.**—A straight-fibered, non-elastic wool.

**BROAD TAIL.**—The grade of Karakul lambskin lower than astrakhan is known as broad tail. Broad-tail skins are taken from lambs prematurely born. Their hair is shorter than that on Persian lambskins, and instead of being tightly curled it is swirled, and exhibits a very attractive wavy pattern. Woven fabrics manufactured to imitate the broad-tail effect are usually called karakul or caracul in the trade.

**BROAD-TAILED SHEEP.**—Practically the same as fat-tailed sheep.

**BROKEN WOOL.**—That which has become detached or been torn from the fleece.

**BROKES.**—Short wool found around the edges of the belly and neck.

**BRUSHED WOOLS.**—This term is only applicable to pulled wools, and is taken from the scrubbing or brushing process, which removes burrs, sand, dirt and other foreign substances from the fleeces. This brushing process takes place while the wool is still a part of the pelt.

**BUCK.**—A male goat used for breeding.

**BUCK FLEECES.**—Fleeces shorn from rams.

**BUTTS.**—Heavy dungy locks. Butts and tags are the same.

**CAPE WOOLS.**—These wools are produced in British South

Africa, and are also known as South African wools. The name was first given to the wools produced in Cape Colony, which in turn was named from the Cape of Good Hope.

**CARACUL.**—This is another spelling for Karakul.

**CARBONIZED WOOL.**—That which has been treated with a solution of sulphuric acid to remove the vegetable matter. Carbonizing is more commonly practiced with clothing wools.

**CARDING.**—Consists of opening the wool staples, separating the fibers to a certain extent, condensing and delivering the opened wool in a continuous strand or sliver.

**CARDING WOOLS.**—Wools best adapted by their short length for processing on the woolen system.

**CARPET WOOL.**—Low, coarse wool, usually obtained from native, unimproved sheep and used in the manufacture of carpets. There is very little produced in the United States.

**CASING.**—To separate and pack fleeces of the same quality in bales or sacks.

**CHARACTER.**—A true, sound stapled wool with evenness of quality and regularity of crimp and serrations.

**CLASSING.**—A term used in Australia for grading fleeces after they have been skirted.

**CLOTHING WOOLS.**—Same as carding wools.

**CLOUDY WOOL.**—Such wool shows the presence of discolorations in the fleece on various parts of the body. It is usually due to rain dripping down on sheep from leaky roofs, irregular and uneven exposure, or inheritance. It is seldom found in the fleeces from range sheep.

**COLD TEST.**—Shrinkage tests are known as cold tests when the scoured wool is allowed to stand several hours after drying in order to regain moisture.

**COLONIAL WOOLS.**—This term is applied to the wools of Australia, New Zealand and South Africa.

**CRUTCHINGS.**—Colonial term for pieces.

**COMBING.**—An operation in worsted manufacture which straightens the fibers, and separates the short, weak and tangled

fibers known as noils from the continuous strand of long, parallel fibers known as top.

**COMBING WOOL.**—That which is best adapted for making worsted yarns.

**COMEBACK.**—In America this refers to a wool fine in quality and having more length than would ordinarily be expected. In Australia, it is the result of breeding crossbreds back toward pure Merinos, one of the parents being a pure-blood Merino.

**CONCORDIA WOOL.**—Located in Argentina on the Uruguay River is the city of Concordia. It is the main shipping point for the wools grown in northern Uruguay and contiguous territory in Argentina.

**CONDITION.**—Refers to the degree of oil in grease wool. It largely regulates the price. In scoured wool it is used to indicate the degree of moisture.

**COTTED FLEECE.**—A cotted fleece is one in which the fibers close to body are matted or tangled. This condition may be caused by ill health of the sheep, such as a fever, or the absence of the proper amounts of yolk or grease in the wool. These fleeces are often produced by very old sheep with low vitality.

**COW-TAIL.**—A very coarse fleece, or exceptionally coarse britch wool. More like hair than wool.

**CRIMP.**—The natural waviness of the wool fiber. Uniformity and abundance of crimp indicate superior wool. The term crimp is sometimes applied only to Merino wools where the waves are frequent and sharply defined, leaving the term waviness to describe other wools not possessing this feature to such a high degree.

**CROSSBRED.**—The offspring resulting from mating a ram and ewe of different breeds, usually a Merino ewe, with a long-wool ram.

**CROSSBRED WOOLS.**—Wools obtained from crossbred sheep.

**CULLS.**—Sheep which are below a required standard.

**DAM.**—Same as ewe.

**DAMP WOOL.**—When stored in a damp condition wool becomes

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discolored and turns yellow. This cannot be removed by scouring, and prevents its use in white yarns, thereby lowering its value. Pronounced forms of mildew are liable to develop and weaken the wool, lowering its spinning properties.

**DEFECTIVE.**—Denotes that something will show disadvantageously after the wool is scoured. Fire, water, vegetable matter or moths may cause defective wools. California burry wool is quoted as defective.

**DEGREASED WOOL.**—Wool from which the grease and dirt have been extracted by the naphtha process.

**DEMI-LUSTER.**—Wool that is not sufficiently lustrous or bright to be classed or graded with pure-bred luster wool.

**DELAINE WOOL.**—Delaine originally referred to a fine type of women's dress goods. Delaine wools are fine combing wools from Ohio and vicinity, but not necessarily confined to the Delaine Merino.

**DENSITY.**—The number of fibers produced on a given area of the sheep's body. The more numerous the fibers the greater the density.

**DEPILATORY.**—An application used to take off hair. The compound used in wool pulling usually consists of sodium sulphide, sulphuric acid and oyster shells. The latter yield lime.

**DOE.**—A female goat.

**DOMESTIC WOOL.**—(a) General meaning includes all wools grown in this country as distinguished from foreign wools. (b) In a strict sense wools grown in this country, east of the Rockies, and raised under farming conditions.

**DOWNRIGHTS.**—In England this term is applied to the short wool obtained from the neck portion of the fleece.

**DOWN WOOLS.**—Wools produced by the British down breeds of sheep, such as the Southdown, Hampshire, Shropshire, etc.

**DOWNY WOOLS.**—Very soft to the touch.

**EASTERN PULLED WOOLS.**—Pulled wools obtained from the slaughter houses of the East, therefore domestic wools are super-

STUTTERING WOOL

APPENDIX

rior to the Western pulled wools which are principally territory wools.

**EWE.**—A female sheep.

**EXTRACT WOOL.**—Recovered wool fiber obtained from rags containing a percentage of cotton.

**FALL WOOL.**—Wool shorn in the fall, and represents a five to six months' growth, and is the second shearing in the year.

**FAT-TAILED SHEEP.**—These sheep are common sheep and native to Asia, Asia Minor, Russia and the Balkan States. The fat, which is secured from the enormous tails of these sheep, is the most valuable product of the carcass. The fleeces are unusually kempy and grade as carpet wools.

**FELLMONGERING.**—A term used to describe the removal of wool from sheep pelts.

**FELTING.**—The property wool possesses of matting or felting together.

**FILLING (WEFT).**—Threads that run crosswise in cloth and fill in between the warp interlacings.

**FLAT-TAILED SHEEP.**—Similar to fat-tailed sheep.

**FLEECE.**—The coat of wool which covers a sheep, or that is shorn from a sheep at one time, usually representing one year's growth.

**FLOCKS.**—Short waste fibers obtained from cloth in fulling, napping and shearing.

**FREE.**—This term is used to indicate the absence of defects. The usual meaning is free from burrs.

**FRENCH SYSTEM.**—This method of processing produces worsted yarn from shorter staple wool than the Bradford System. It is usually mule spun. The yarn is softer, bulkier and loftier than Bradford yarn. No twist is introduced in the processes preceding actual spinning.

**FRIBS.**—Short and dirty locks of small size. Dungy bits of wool and second cuts.

**FROWSY WOOL.**—A lifeless-appearing wool with the fibers lying

more or less topsy-turvy. The opposite of lofty wool. Usually dry and harsh.

**GARNETTED STOCK.**—Recovered fiber obtained by treatment of garnett machine on rags or thread waste.

**GRADE.**—(a) The quality or relative fineness of the wool. (b) Sheep of mixed blood, showing no particular breed characteristics. The term is also applied to crossbred sheep.

**GRADING.**—Classifying the fleeces according to fineness and length of staple and availability for the various mill requirements without untying the string.

**GREASE WOOL.**—Wool as it comes from living sheep with the grease still in it.

**GRITTY.**—Wool containing an excessive quantity of sand or grit.

**GUMMY FLEECE.**—This is due to the coagulated yolk, and is often caused by shearing the fleece while damp.

**HAIR.**—Usually straight, non-elastic and glossy. Stronger, smoother and usually coarser than wool. Lacks felting properties.

**HALF-COMBING WOOLS.**—Medium wools such as produced by the British down breeds were at one time widely known as half-combing wools.

**HARD WASTES.**—These are also known as yarn waste, thread waste and hard ends. The spinning, spooling, winding, warp dressing and weaving departments are the principal contributing sources for hard wastes.

**HOG OR HOGGETT WOOL.**—English term for the first fleece shorn from a sheep about one year old. Naturally finer and longer than wether wools and classes a trifle higher.

**“HOT-HOUSE” LAMBS.**—This term is given to lambs dropped in the fall and winter. They are also known as winter lambs.

**HOT TEST.**—This is the name applied to a shrinkage test when the scoured wool is weighed immediately after drying.

**KARAKUL.**—(a) A breed of sheep native to Bokhara in Central Asia. Important owing to the valuable fur produced on the

lambskins. (b) Woven fabrics made to imitate natural broadtail are termed karakuls in the trade. The name "karakul" is taken from the village of Kara Kul (black lake), in the eastern part of Bokhara.

**KEMP.**—Dead fibers, chalky white and without luster. Larger diameter than surrounding wool fibers. Resists dyestuffs and is deficient in felting properties.

**KID.**—A young goat.

**LAMB.**—A young sheep.

**LAMB'S WOOL.**—Wool shorn from lambs up to seven months old. Soft and possessing superior spinning properties over wools of equal quality shorn from older sheep. This is due to the fiber ends retaining the natural tip, while the fiber ends have been cut by a previous shearing on older sheep and are therefore blunt.

**LEAN WOOL.**—Wool with very poor spinning properties. Especially deficient in waviness.

**LINE FLEECES.**—Those midway between two grades as to quality or length.

**LIVE WOOL.**—Lofty wool shorn from living sheep.

**LOFTY WOOL.**—Open wool, full of "life." Springs back into normal position after being crushed in the hand. Very elastic.

**LUSTER WOOL.**—This is obtained from long-wool sheep, such as the Lincoln, Leicester, Cotswold, etc. It is known as luster wool because the coarse fibers reflect light. It is also known as braid wool.

**MATCHINGS.**—Portions of fleeces of the same quality from which all inferior wool has been removed.

**MEDIUM WOOLS.**—(a) Those wools which average in length between long and short wools. (b) Sometimes refers to the general quality. In such cases the term includes the grades high  $\frac{1}{4}$ -blood,  $\frac{3}{8}$ -blood and low  $\frac{1}{2}$ -blood wools.

**MERRIN WOOL.**—This is secured from the decomposed remains of Merino sheep on the Western ranges. After scouring it has an old-ivory tint, and is very difficult to bleach. Merrin wool possesses unnatural softness.

**MODOC.**—Reclaimed wool fiber from hard-woven and fulled fabrics.

**NATIVE WOOLS.**—This term is applied to those wools produced east of the Mississippi River.

**NOIL.**—A by-product of worsted manufacture during combing consisting of short and tangled fibers under a desired length. It is used as a raw material in the manufacture of woolens.

**OFF SORTS.**—The by-products of sorting consisting of the less desirable parts of the fleece. In fine staple or any other grade there are certain quantities of short, coarse, stained and colored wools. These are the off sorts.

**ORDINARY.**—The term "ordinary" is sometimes used for territory clothing or carding wools. In such cases it distinguishes the wool so described from "staple."

**PERSIAN LAMB.**—This is the best grade of Karakul lambskins. They have the most pronounced, most uniform and tightest curls. The term Persian was given to them for the reason that at one time all these skins found their way to the European markets from Persia, and the impression then prevailed that practically all the skins were produced in Persia.

**PICKLOCK WOOL.**—Formerly a grade above XX. Picklock was the product of Silesian and Saxony Merino blood. There is no American market grade of that name at present, as there is practically none of this wool on the American market. A very small quantity of this quality of wool is produced in West Virginia.

**PIECES.**—The wool removed by skirting the fleece.

**POLLED.**—Without horns.

**PORT PHILLIP WOOLS.**—Wools raised in the southern part of Victoria, and shipped through Melbourne and Geelong are known as Port Phillip wools. Port Phillip is an extensive bay on the southern coast of the State of Victoria, and the two important wool centers named above are located on its shores.

**PULLED WOOL.**—Wool taken from the skin of a slaughtered sheep's pelt by slipping, sweating or the use of depilatory.

**PUNTA ARENAS WOOL.**—Punta Arenas is a seaport in Chile on the Straits of Magellan. Large quantities of low crossbred combing wools especially suitable for knitting yarns are grown in neighboring provinces of both Argentina and Chile, and are shipped from this town.

**QUALITY.**—The diameter and relative fineness of the wool. It largely determines the spinning quality.

**RAM.**—A male sheep used for breeding. A ram produces longer and stronger wool than ewes and wethers.

**RANGE WOOL.**—That shorn from sheep raised under ranching conditions. In the United States, better known as territory wool.

**REGAIN.**—This term refers to the amount of moisture absorbed from the air by scoured wool after leaving the dryer.

**REJECTS.**—Off-grades and off-sorts, such as cotted fleeces, black wool, tender wool, too much kemp and fleeces with a vile odor shorn from sick sheep or decaying carcasses. Also fleeces containing considerable vegetable matter.

**RIVERINA WOOLS.**—These come from river lands in the State of Victoria, Australia.

**RUN-OUT FLEECE.**—One that is not uniform, but much coarser on the "britch" than elsewhere. Lacking character. It may contain a large amount of kemp.

**SECOND CUTS.**—Careless shearing sometimes results in cutting wool which has already been shorn once. This produces short fibers known as fribs and second cuts.

**SCRUBBED WOOLS.**—Same as brushed wools.

**SEMI-BRIGHT WOOL.**—Brighter than territory wool, but too dark to be classed as bright.

**SHAFTY WOOL.**—Wool of good length and spinning properties.

**SHEARING.**—The removal of the fleece of wool from the sheep.

**SHEARLINGS.**—Short wool pulled from skins of sheep shorn before slaughtering. Also an English term for yearling sheep.

**SHIVY WOOL.**—A somewhat broad term. It refers to the presence of small particles of vegetable matter in the wool, such as burrs, stickers, leaves, twigs and stems.

**SHODDY.**—(a) In its broad meaning, wool that has been previously made into yarn or fabrics, torn apart and made ready for use again. (b) In a strict sense, the term applies to recovered wool fiber obtained from soft all-wool rags.

**SHRINKAGE.**—The loss due to removal of grease, suint and foreign matter when grease wool is scoured.

**SIRE.**—Same as ram.

**SKIN WOOL.**—Same as pulled wool.

**SKIRTING.**—This consists in removing the neck, belly and leg pieces and the low quality wool of the britch from the edges of the fleece. It is the universal method of preparing wools for market in Australia and New Zealand.

**SLIPE WOOL (SLAPE, SLIPY).**—A Yorkshire dialect word, meaning "slip" or "slippery."

All pulled wool treated with lime is slipy wool and much pulled wool not treated with lime is also slipy wool. The lower the grade, the more it has a tendency to be slipy. There are wools other than pulled wools that are slipy. Wools that have been sheared from sheep that have been so-called hurriedly fattened for the market are recognized as slipy wool. Wools from old ewes that have passed their usefulness and are fattened up for the butcher will produce wools as above mentioned, slipy. The lower grades become more slipy than the higher grades.

All mohair is slipy compared with wool, yet it is rarely referred to as a slipy material. In sorting mohair, a slipy fleece can be recognized, just as you can tell a fat sheep fleece in sorting ordinary wool. Overfeeding is the cause in both cases. There is a wonderful difference as to wool of well-fed sheep and one that is underfed.

**SOFT WASTES.**—These include card strippings, card fly and soft floor sweepings. Also included are sliver, top, slubbing and roving wastes, but these seldom reach the market, as they are usually worked up by the mill in which they originate.

**SORTING.**—The classification and division of the wool fibers

in a fleece into various groups or sorts, according to fineness, length, soundness, elasticity, spinning and other properties.

**SPRING WOOL.**—Six to eight months' growth; shorn in the spring where sheep are sheared twice a year.

**STAINED WOOL.**—That which is discolored by urine, dung, etc.

**STAPLE.**—(a) A lock or bunch of wool as it exists in the fleece. (b) Territory combing wool. (c) Having reference to the length of the fiber.

**STAR LOTS.**—Lots of wool consisting of one, two or three bales offered at the London Auctions are known as star lots.

**STUBBLE SHEARING.**—Shearing some distance from the skin, leaving a "stubble."

**SUI GENERIS.**—This Latin term means of its own kind; in other words, an original and distinctive type without relationship with any other type.

**SUINT.**—Excretions from sweat glands deposited in the wool.

**SUPER.**—This trade term is apparently without a definite meaning, and when used, it is applied to medium pulled wools, such as B super and C super. However, the term is seldom used, and is fast disappearing. It is probably an abbreviation for the word superior. In Great Britain, "super" is a grade term, and represents wools between the grades of "pick" and "selected."

**SWEATING SHEDS.**—Sheds in which sheep are "sweated" before shearing. The object is to raise the yolk and make shearing easier.

**TAGS.**—Large dungy locks.

**TEG OR TEGGETT.**—English term. Same as hog or hoggett, but is applied to shorter wools.

**TERRITORY WOOLS.**—Territory wools are in general those which come from the territory comprising the Intermountain States.

**TIPPY WOOL.**—Wool in which the tip or weather end of the fiber is more or less incrusted.

**TOP.**—A continuous untwisted strand of the longer wool fibers straightened by combing. The short fibers or noil have been

removed by the comb leaving the top. After reducing, drawing and spinning it becomes worsted yarn.

**TOP-MAKERS' QUALITIES OR COUNTS.**—Top-makers' qualities or counts are the numbers used in designating the quality of certain foreign wools. They range from 12's upwards. The numbers are supposed to indicate the number of hanks of yarn to which a pound of top will spin. Each hank represents 560 yards.

**TUB WASHED.**—Wool that has been washed in the fleece after having been sheared. Very rare in America; this practice was formerly practiced in Kentucky.

**UNMERCHANTABLE.**—Fleeces containing an unusual amount of chaff, burrs, seeds or straw, usually necessitating carbonizing, and therefore of inferior value compared with other similar wools free from such foreign matter. Also includes wool that has been poorly washed upon the sheep's back, or the wool allowed to remain on the sheep for some time before shearing, after having been washed.

**VAN WOOL.**—This name is given Merino wools grown in Tasmania.

**VIRGIN WOOL.**—Wool sheared from live sheep, and of course not previously used in manufacturing.

**WARP.**—The threads which run lengthwise in cloth.

**WASHED WOOLS.**—Those from which the suint has been removed by washing the sheep before shearing.

**WESTERN WOOLS.**—Often applied to all wools grown west of the Mississippi River. Specifically it designates the true territory wools grown in the Intermountain States.

**WETHER.**—(a) In English wools it refers to wool other than the first clip from the sheep. (b) In sheep, a castrated male.

**WIRY WOOL.**—That which has very poor spinning properties, owing to the poor elasticity and pliability of the fiber.

**WOOLEN SYSTEM.**—After carding, yarns are spun directly on the mule in this system. The fibers are criss-crossed and do not lie in any general order.

WOOL-SORTERS' DISEASE.—See anthrax. When this disease is contracted by wool sorters it is usually caused by a skin abrasion on the hands, and nearly always while working on wools from Asia or from South America.

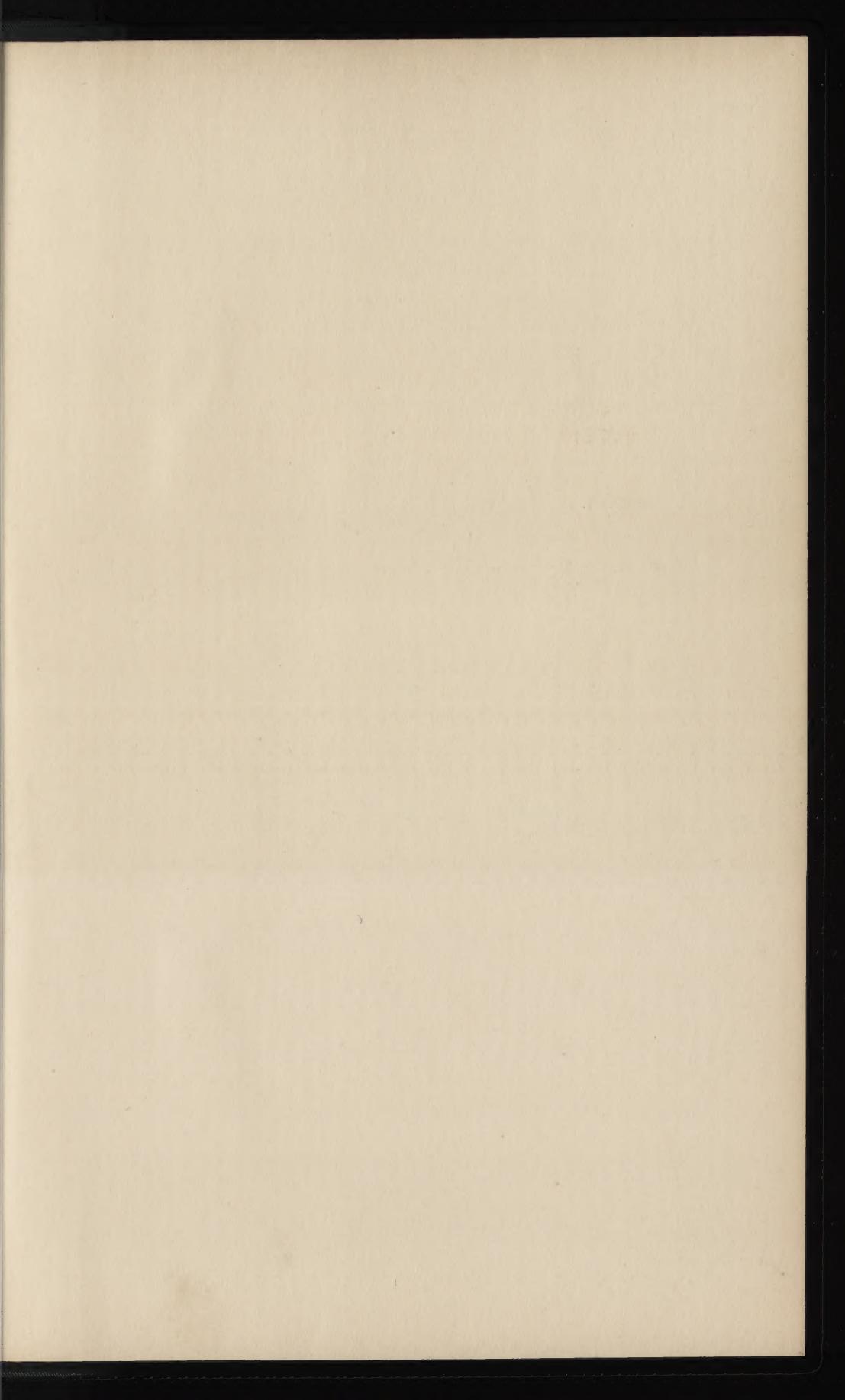
WORSTED.—Yarn spun from top. The wool fibers are paralleled and equalized, and the yarn is smooth compared with woolen yarns. Owing to its structure, a worsted thread does not possess felting properties to the same extent as a woolen. The two systems of manufacturing worsted yarn are the Bradford and French.

YEARLING.—A sheep one year old.

YIELD.—The amount of scoured wool obtained from a definite quantity of grease wool.

YOLK.—The fatty grease deposited on the wool fibers from the oil glands.

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